Palestine Polytechnic University

College of Engineering

Title

Electrical System, Lighting and Supporting Works Design for Commercial Mall in Hebron

By

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Submitted to the College of Engineering
in partial fulfillment of the requirements for the degree of
Bachelor degree in Electrical Engineering

Palestine Polytechnic University

2021

Abstract

Electrical design, lightening and low current designs are an essential and basic designs that are required in every constructors from houses to hospitals to commercial buildings, and even in small stores, and neglecting any important factor in the design of electrical, lighting and light current works will cause a failure in the design, and this failure may lead to problems that may cause material or human losses , so we need to design an electrical, lighting and light current works based on the approved codes and specifications.

This project aims to design an electrical, lighting and light current works for a commercial mall, based on the approved codes and specifications, as we believe that   comfort, attractiveness and safety will be achieved for the building users through careful design of lighting and other electrical services.by using some software such as, AutoCAD, Dialux and Ecodial .

Abbreviations

Circuit Breakers	*CB*
Short Circuit Capacity	*SCC*
Miniature Circuit Breakers	*MCB*
Molded Case Circuit Breaker	*MCCB*
Ground Fault Circuit Breaker	*GFCB*
Local Area Network	*LAN*
Unshielded Twisted pair	*UTP*
Shielded Twisted Pair	*STP*
Heating – Ventilation and Air Condition	**HVAC**
Un-interrupted Power Supply	**UPS**
Ring main unit	**RMU**
Rated current	I_{rated}
National Electric Code	**NEC**
polymerizing vinyl chloride	**PVC**
Cross-linked polyethylene	**XLPE**
System International	**SI**
Locked Rotor Amperes	**LRA**
Minimum Branch-Circuit Selection Current	**MBCSC**
Maximum Overcurrent Protective	**MOP**
Main Earthing Terminal	**MET**
Bas Bar	**BB**

Internet Protocol	**IP**
Local Area Network	**LAN**
Wide Area Network	**WAN**
Internet Protocol television	**IPTV**
Unshielded Twisted pair	**UTP**
Shielded Twisted Pair	**STP**
Media Access Control	**Mac**
Television	**TV**
Closed Circuits Televisions	**CCTV**
Video Cassette Recorder	**VCR**
Digital Video Recorder	**DVR**
Pan Tilt Zoom	**PTZ**
High-definition video	***HD***
Network Video Recording	**NVR**
FIRE ALARM CONTROL PANEL	**FACP**
Telephone Box	**TB**
Private automatic branch exchange	**PABX**
VOICE OVER INTERNET PROTOCOL	**VOIP**
Registered Jack	***RJ***
Internet Protocol Private Branch Exchange	**IP-PBX**

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CHAPTER 1

INTRODUCTION

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1.1 Overview

Electrical designs, lighting, and support works are one of the basic knowledges that an electrical engineer must be familiar with and professionalize, as all establishments ranging from houses to hospitals, hotels and commercial establishments all need these designs, and electrical works are the most interfering with Other works, as civil or mechanical works, and hence the importance of studying electrical designs, as it will affect all other works.

1.2 Background and statement of the problem

Most engineering offices do not take consideration to all the important factors in the design of electrical, lighting and light current works, so this project came to fulfill all the important considerations in design with the highest possible quality than that in the labor market.

1.3 Objectives

To design an electrical, lighting and light current works for a commercial mall, based on the approved codes and specifications.

1.4 Importance

Achieve comfort, attractiveness and safety for the building users through careful design of lighting and other electrical services.

1.5 Research method

Collecting information from approved codes, references, and field visits to engineering offices.

Software's used:

- AutoCAD
- Dialux

1.6 Time plan

Table1.1: Time plan

	Description of Work	Start and End Dates
Phase One	Find the idea and agree on it	First week
Phase Two	Search for codes used in designs, books and articles specialized in this field	second week - fifth week
Phase Three	Starting visits to engineering offices	Sixth week - tenth week
Phase four	Specify the project and the necessary engineering plan And start preliminary designs for the project	The eleventh week - end of the semester

1.6 Expected results

The expected results is to design an Electrical ,also lightening and light current systems works for a commercial mall, based on the approved codes and specifications, and this designs will be at stages as we see in the block-diagram in Figure1.1, as some of these stages will be done in this semester(Load estimation ,transformer and generator seizing and electrical room design), and the

rest will be done in the next semester(lightening design, socket distribution, low current design, BMS system design , main and sub-main distribution boards, riser diagram, and earthing system)

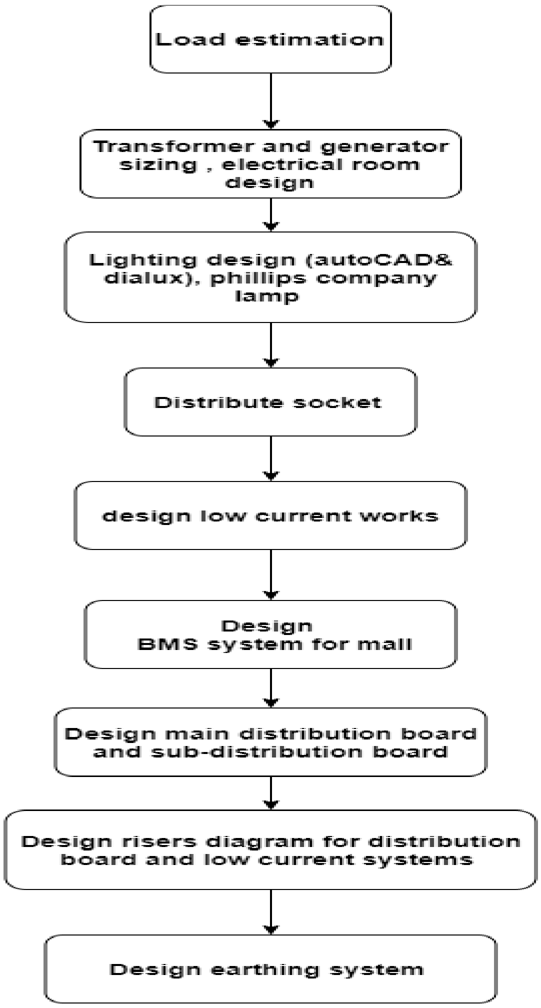


Figure 1.1: Block diagram of design electrical installations for commercial mall in Hebron

CHAPTER 2

The main feeding for the mall

2.1 Overveiw :

The city of Hebron is considered a major commercial center in Palestine, so commercial malls are important elements in the city. This is one of the most important reasons for choosing a commercial mall project to work on the optimal design of electrical installations with its various elements to achieve the optimum design that provides comfort and luxury in the mall.

2.2 Location of mall:

The mall is located on the western side of Ain Sarah Street on a land area of 1260 m^2

With a total area of 5773.3 m^2, It consists of 9 floors and two floors for garages, it was designed by Engineer Hamza Rasheed, an architectural engineering graduate from Palestine Polytechnic University.

4 Load Estimation

The first step in designing the electrical installations for any building is to estimate the loads. Through it we can determine the size of the transformer and emergency generator needed for the building and the area of the rooms for electrical equipment.

The loads for the project were estimated based on the American code NEC, where the loads of lighting, sockets, air conditioning, light current and other devices such as fire pumps were estimated. Due to the nature of the mall and its needs, the lighting and air conditioning loads are the highest among the loads.

The server room load is estimated at 500VA / m^2

elevator loads:

To estimate the elevator loads, the following figure was used. As the mall contains two elevators, the demand factor is 0.85 and the gearless elevator speed based on the number of floors is 2 m / s. The total weight of the cabin and the people in the elevator is 1750 kg.

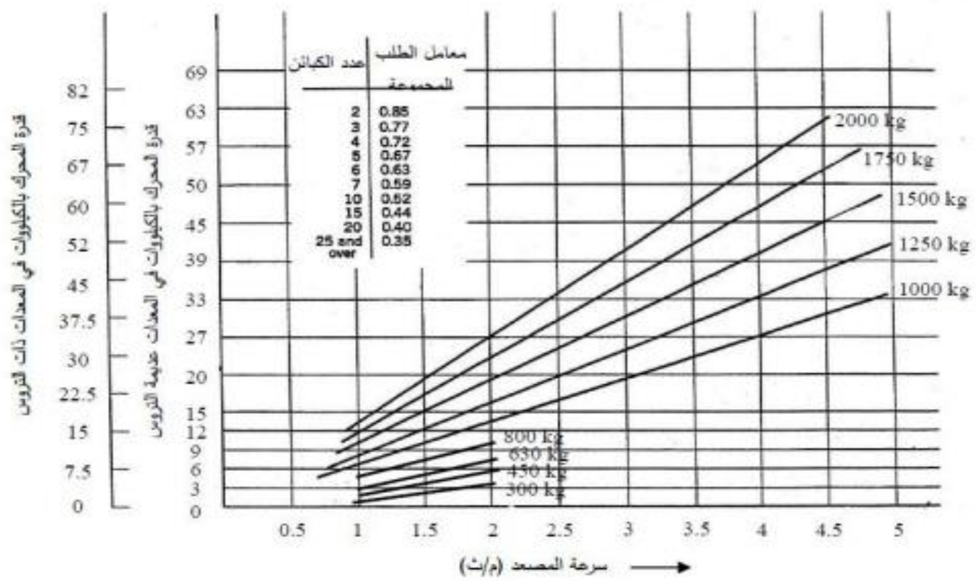


Figure 2.1: Speed of elevators with power. **[1]**

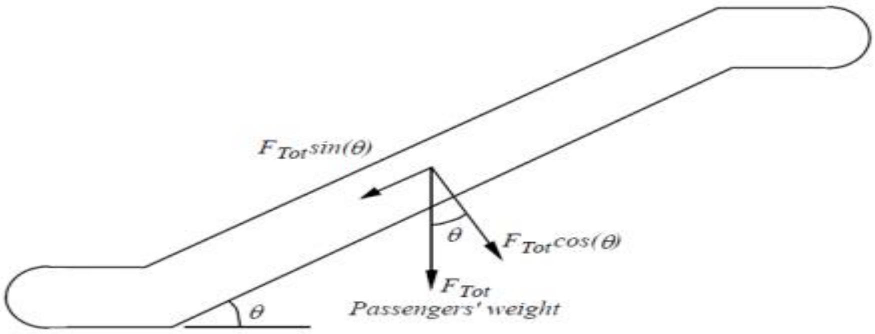
From figure the power of elevator is 25 kw

Power in KVA= $\frac{power(kw)*demand\ factor}{power\ factor} = \frac{2*25kw*0.85}{0.85}$ = 50 KVA

Escalator load

The escalator is one of the most important parts of the mall, and in this project it serves 4 floors

The following picture shows the equation that is used to calculate the required motor power for the escalator



$$P = \frac{m \times g \times n \times (\frac{RE}{Rs}) \times \sin\theta \ \times s + P_H}{\eta s \times \eta G \times 1000}$$

Figure 2.2: Speed of elevators with power. **[1]**

Where :

P: Is the output power required from the motor in kw

M: Is the average mass per passenger in kg

G: is the acceleration due the gravity (9.8 m $/s^2$)

N: is the number of passenger per step (1,1.5,2)

RE: is the vertical rise of the escaloror in meters

RS: is the step rise in meters

Φ: is the angle of inclination of the escalator

S: Is the linear speed of the escalator in meters per second

PH: the power in watt need to keep handroils moving

µs :efficiency of the step band

µG :efficiency of the gearbox

The escalator was chosen from Schneider and the following picture is the specifications of the escalator

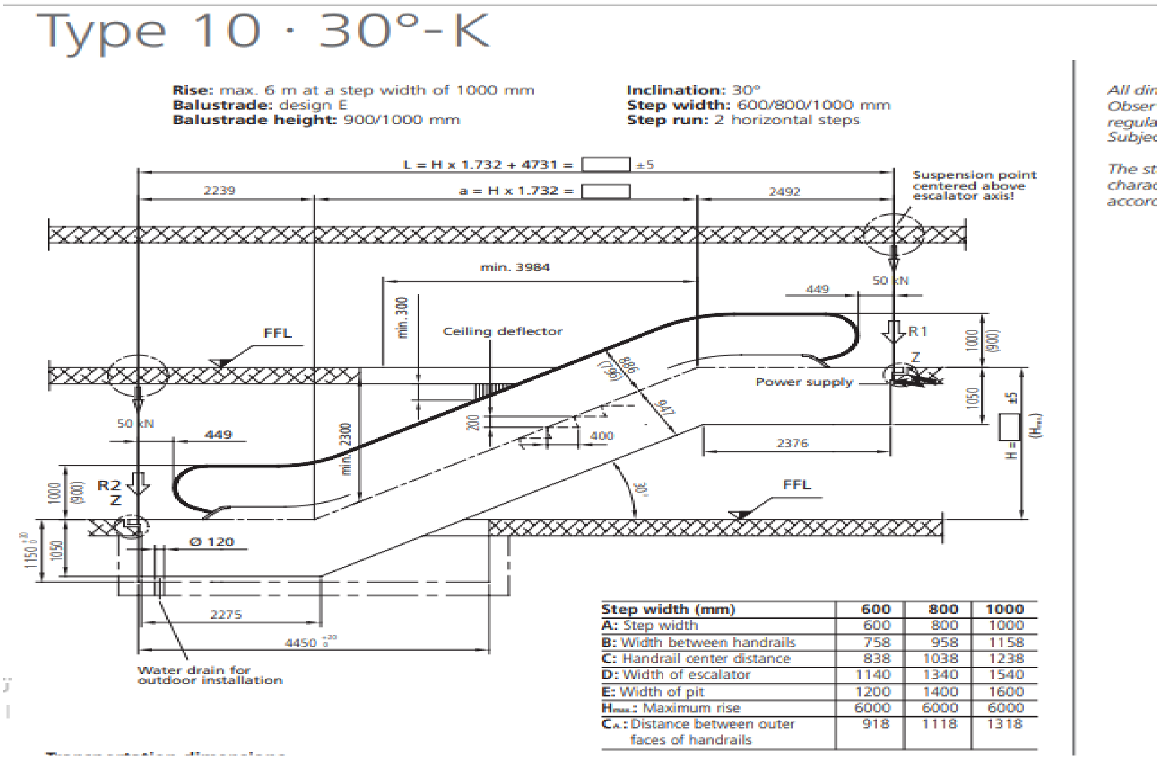


Figure 2.3: Speed of elevators with power. **[1]**

$$P = \frac{58 * \frac{12}{0.6} \sin 30 * 0.75 + 4000}{0.85 * 1000} = 19.2KW$$

Water pump load:

Water pump loads are usually low for commercial buildings, the power of water pump is 15 kw.

$$\text{Power in KVA} = \frac{15kw}{0.85} = 18KVA$$

fire pump load:

To calculate the required fire pump capacity, using the following equation

$$W = \frac{QP}{600 * efficiency} .[1]$$

Where:

W: power in KW

Q: Required flow) liter/ minute), according to the of Level severity of the expected fire

P: The pressure required at this flow

Efficiency: (70-80) %

Table 2.1: The level of severity with the required amount of flow from the pump.**[1]**

Level of severity	**The hight difference of pump low buildings**	**Nominal rated to add to largest outlet pressure**	
Normal (third group)	More than 30 m	The pressure at the pump outlet (bar)	Flow Liter/minute
		2.5	3100

According to table 4.2, for this project that it's highest is 38 m

$$W = \frac{3100*2.5}{600*0.75} = 17 \text{ kw}$$

$$\text{In KVA} = \frac{17kw}{0.85} = 20 \text{ KVA}$$

Table 2.1: load estimation for the commercial mall**.**

Category	**Area (m^2)**	**Estimated load (KVA)**
Management	125	11.525
Shops	1630	159.13
Restaurants	250	33
Stores	360	3.912
Yards and inner gardens	700	59.5
Services	450	43.4
Corridors	1161.3	68.0943
carpark	1125	45
Server room	6	3
Cooking and water heating appliances		100
Water pump		18
Fire pump		20
2 elevators		50
Total estimated load		**751.26**

This matches the final calculations for the building

Table 2.2: load calculation for the commercial mall**.**

DB No.	load kw	I (A)	CB	Cable Size (mm2)	Distance(m)	Voltage drop (mv/AMP/ meter)	V.D (V)	V.D % < 2.5%	Circuit load in KW R	Y	B
DB-EXT	1.4	2.363	3*16	5*6	0.5	5.576	0.0066	TRUE	0.466	0.466	0.466
DB-B1	11.762	19.85	3*25	5*6	3	5.576	0.3321	TRUE	4	4	3.762
DB-B2	11.774	19.9	3*25	5*6	6	5.5765	0.6658	TRUE	3.906	3.868	4
DB-GF	53.583	90.56	3*125	3*70+2*35	11	0.588	0.5858	TRUE	17.808	18.105	17.67
DB-F1	42.814	72.36	3*100	3*50+2*25	17	0.802	0.9866	TRUE	13.833	13.912	15.07
DB-F2	63.824	107.87	3*125	3*70+2*35	20	0.802	1.7303	TRUE	22.724	20.974	20.537
DB-F3	55.231	93.35	3*125	3*70+2*35	23	0.802	1.7219	TRUE	18.346	18.539	18.346
DB-F4	67.973	114.89	3*150	3*95+2*50	26	0.456	1.3621	TRUE	22.724	22.211	23.039
DB-F5	24.883	42.05	3*63	3*25+2*16	29	1.412	1.7219	TRUE	8.25	8.4	8.2327
DB-F6	23.66	39.99	3*50	3*16+2*10	30	2.161	2.5926	TRUE	7.976	7.97	7.714
DB-F7	27.163	45.91	3*63	3*25+2*16	33	1.412	2.1392	TRUE	8.876	9.136	9.15
DB-F8	23.98	40.53	3*50	3*16+2*10	36	2.161	3.1531	TRUE	8.0585	7.885	8.036
DB-F9	22.212	37.54	3*50	3*16+2*10	39	2.161	3.1638	TRUE	7.393	7.4257	7.397
MDB-UPS	28		3*63	3*25+2*16	11	1.412	0	TRUE	9.33	9.33	9.33
DB-Lift1	27	48.26	3*63	3*25+2*16	3	1.412	0.2044	TRUE	9	9	9
DB-Lift2	27		3*63	3*25+2*16	12	1.412	0	TRUE	9	9	9
DB-ECSLA	19.2	34.319	3*50	3*16+2*10	4	2.161	0.2967	TRUE	6.4	6.4	6.4
DB-Water pump	15	26.8	3*40	3*10+2*6	40	3.367	3.6094	TRUE	5	5	5
DB-Fire pump	17	30.38	3*40	3*10+2*6	10	3.367	1.0229	TRUE	5.66	5.66	5.66
									188.751	187.2817	187.81
							Total connected load KW	563.842			
									Un Balanced %		
									1%		
									MAX		MIN
									188.751		187.282

Low Current Load	36 Kw
Total Laod	599.8419
Laod in KVA	749.802375
DF	0.8
Laod after DF	599.8419 KVA

4.5 Transformer Size

Based on the initial estimate, the total load of the mall building was 751.26 KVA . So, the capacity of a suitable transformer (dry type, Cast Resin Transformers family according to International Standards (Copper foil)) is 800 KVA with dimension (L, W, H) 1440 x 850 x 1800 mm and same dimension for RMU.

Distance measures in :	Millimetres
Voltage ratio :	11±2x2,5% / 0,4kV or 10±2x2,5% / 0,4kV;
Insulation levels Primary / Secondary :	12 - 35 - 75 / 1,1 - 3kV
Partial discharge level :	< 10 pC
Insulation thermal class :	F / F - 100 / 100 K
Vector group :	Dyn11
Frequency :	50 Hz
Available environmental classes :	E2 / E3
Available climatic classes :	C1 / C2
Fire classification :	F1
Conductor material :	Copper foil

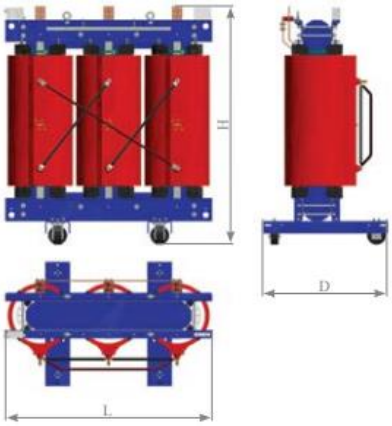


Figure 2.4: Dry type transformer, Cast Resin Transformers family

To calculate the area of the transformer room, a distance of 1 m should be left from each side for maintenance purposes, and the minimum height of the transformer room

= 0.5 m + Transformer height (m).**[3]**

The area of the air inlet calculating by the following equation

h= $\frac{A}{2}$ + (B-A) +0.5.**[3]**

h: The vertical distance between the center of the converter and the center of the air inlet (m)

A: Transformer height (m)

B: Transformer body height (m)

h = $\frac{1.2}{2}$ + (1.8 – 1.2) +0.5 = 1.7 m

From curve the area of the air inlet = 1 m^2

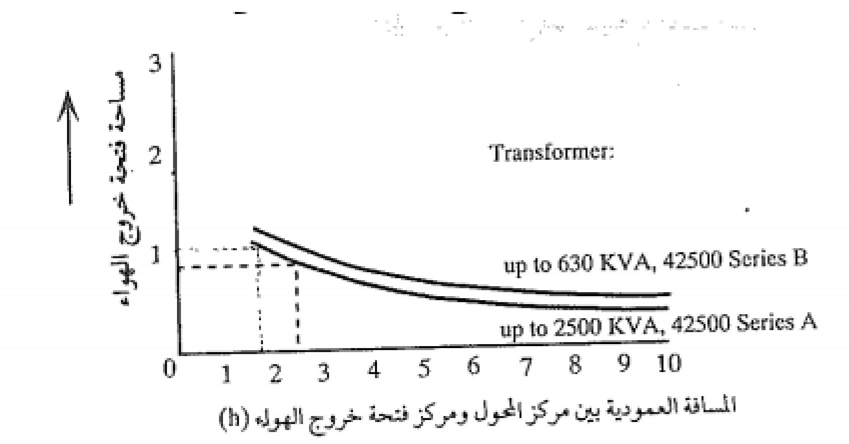


Figure 2.5: The area of the air outlet curve **[3]**

Since air inlet provided with a mesh, the air inlet must be increased by 10%.**[3]**

air inlet area = 1.1 * 1 = 1.1m^2 = The area of the air outlet.

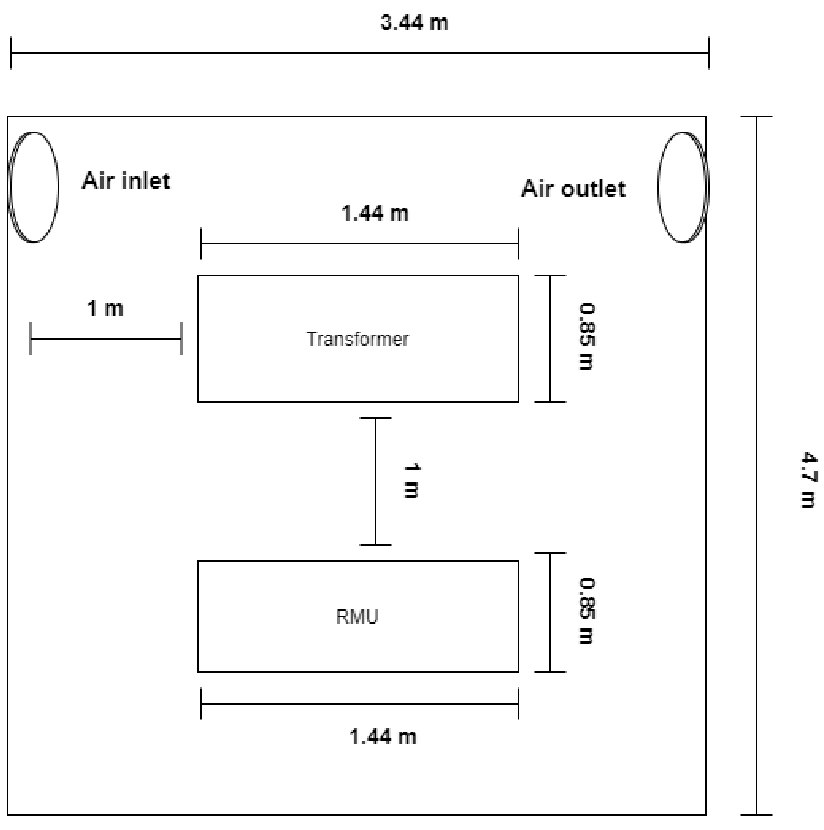


Figure 2.6: The dimension of transformer room

4.6 Emergency Generator size

The emergency generator feeds the critical loads and in the mall the generator will feed the UPS loads, fire pump, water pump, light current loads and one elevator.

- UPS load = 28 KW
- Light current = 36 KW
- Fire pump = 17 KW
- One elevator =27 KW
- Water pump = 15 KW
- Emergency Lighting =7.12 KW

It is preferable to increase the loads by 20% as a future reserve factor.**[3]**

S_G = 1.2 * S_T =1.2 *(24+40.21+20+29.4+18) /0.92 = 169.72 KVA

So, the suitable generator is 170 KVA

Dimensions	Length	Width	Height
Standard open set dimensions	2537	1090	1846
Standard enclosed set dimensions	3460	1090	2387

Genset outline

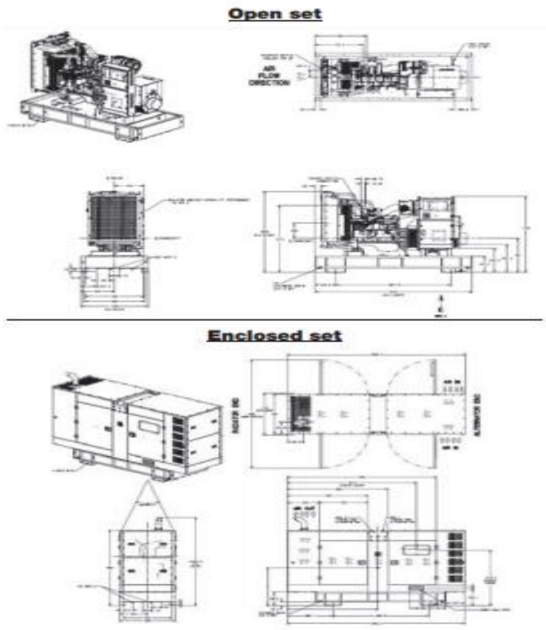


Figure 2.7: The dimension of transformer room

4.7 SITE PLAN

It is a diagram showing the main feeding of the building, electrical rooms, cables and manholes used Manhold cover from Iron pouring Cast Iron strong bearing 25 written on it Electric

As for the pipes used

• 3 or 4”PVC for Communication Lines.

• 4” or 6” PVC for Electrical Lines.

This figure shows the main electrical supply scheme for the mall

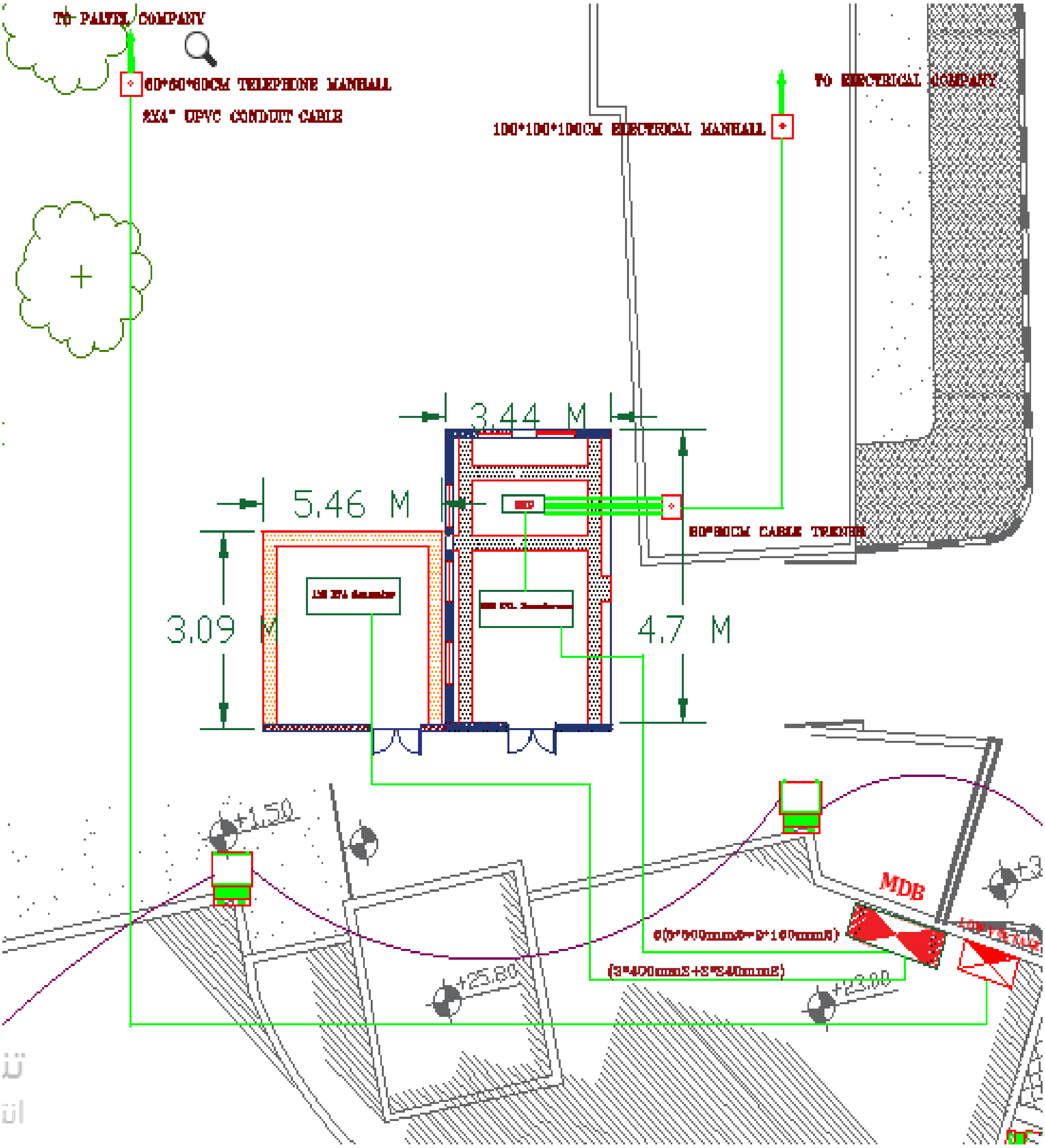
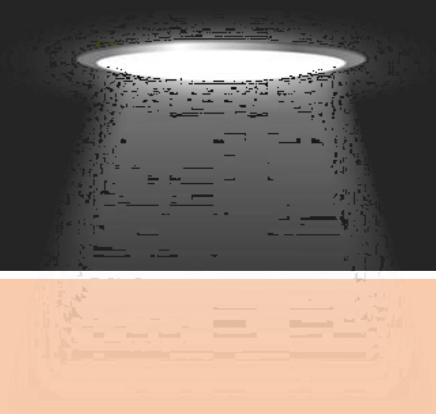


Figure 2.8: The dimension of transformer room

CHAPTER 3



Lighting Design

3.1 Overview:

This chapter about lighting design for the mall by using Dialux evo , Includes lighting design basics and design presentation The main places in the mall in addition the design of emergency lighting.

3.2 Basic Lighting Design

Light is an aesthetic medium and lighting is an engineering art, and the solution to the lighting problem is not only in determining the number of lamps, but in the location and method of placing the lamps to achieve appropriate lighting.

There are several ways to design lighting, the most important of which is the lumen method, which is a method for making an approximate estimate of the size of the lighting system that we intend to establish, and through which the number of lighting devices is determined.

The basic steps for designing a lighting system

1. Determine the amount of lux suitable for the room from the codes
2. Determine the type of lighting device used and the type of lamps
3. Determine the factors of use and maintenance
4. Calculating the number of lighting devices that must be installed in the room to achieve the required lighting

   Room index $K = \frac{A}{h(a+b)}$

$$E = \frac{n.\Phi.U_F\,.M_F}{A}$$

$$n = \frac{E.A}{\Phi.U_F\,.M_F}$$

which

n: The number of bulbs

E:Required luminous intensity

a: length of room

b: width of room

A: Operating level space

$U_F : utlization\ gactor\ (less\ than\ 1\ )$

$M_F : Maintenance\ factor\ (less\ than\ 1)$

The design was based on the Jordanian code, which is mainly based on the British Lighting Engineers Association(IEC) and the British Institute for Building Services(CIBSE), and is compatible with the International Lighting Authority (CIE)
The Dialax Evo program was used to design the lighting , and choose the lamps, it was based on what the manufacturer proposes, which is the Philips.

3.3 Lighting for car parking and electrical room:

The mall contains two floors, underground garages. The second garage includes an electric room. The following table shows the intensity of the dark illumination in addition to other factors

Table 3.1: Luminescent requirements in car parking and electrical room

	Maintained illuminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	(Maintenance Factor	Height of working plan
Parking	75	0	40	2000	0.8	0
Electrical room	200	25	60	3000	0.8	0.8

A luminaire of type TCW060 was chosen from Philips. This type is characterized by being economical, energy saving, easy to install and maintain.

PHILIPS

P	72.0 W
Φ_{Lamp}	6500 lm

Figure3.1 : TCW060 luminaire

P_{total}	A_{Room}	Lighting power density
1440.0 W	737.01 m²	1.95 W/m² (Room)

pcs.	Manufacturer	Article No.	Article name	P	$\Phi_{Luminaire}$
20	PHILIPS		TCW060 2xTL-D36W HF	72.0 W	4087 lm

Figure 3.2 : The power consumption in second garage

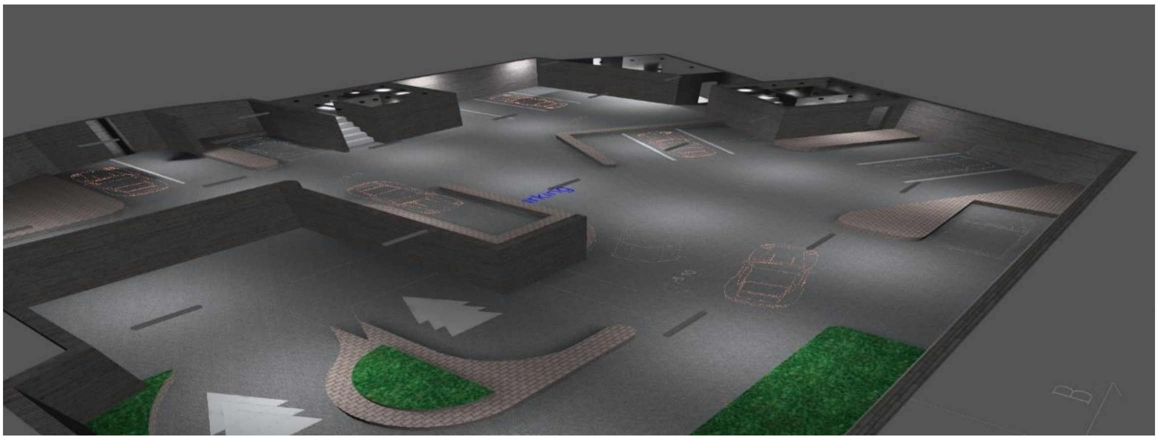


Figure 3.3: The second garage 3D

Electrical room

For electrical room a luminaire of type GreenSpace was chosen , extremely low power consumption, while delivering consistent light output, stable color performance and high color rendering. The product's long lifetime.

PHILIPS

P	16.8 W
Φ_{Lamp}	2100 lm
$\Phi_{Luminaire}$	2099 lm
η	99.93 %
Luminous efficacy	124.9 lm/W
CCT	3000 K

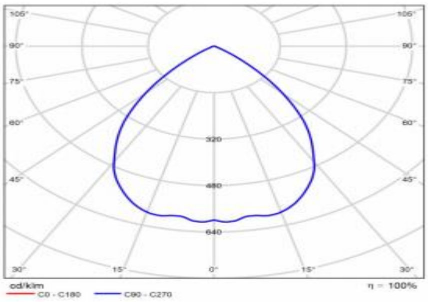


Figure3.4 : GreenSpace luminaire

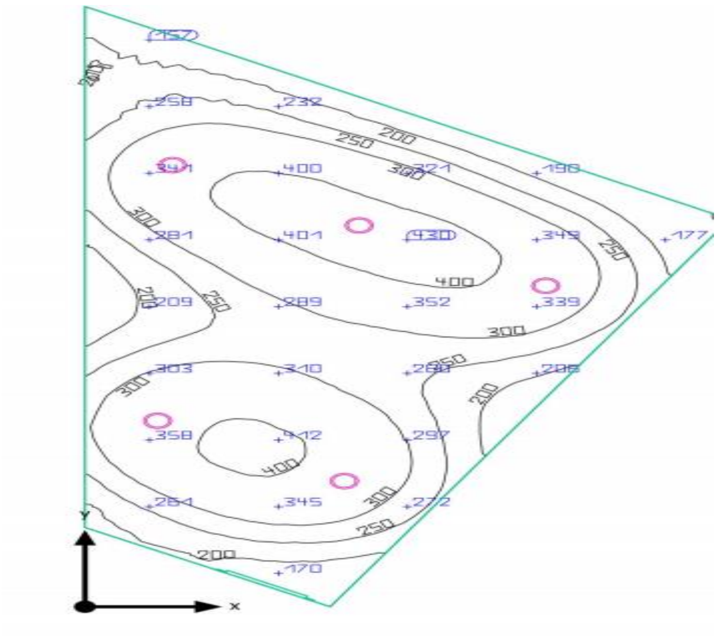


Figure 3.5: the distribution of luminous flux for electrical room

Table 3.2 : the calculation results for electrical room

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	293 lx	≥ 200 lx	✓	S9
	g_1	0.31	-	-	S9
Consumption values	Consumption	14 kWh/a	max. 850 kWh/a	✓	
Lighting power density	Room	3.50 W/m²	-	-	
		1.19 W/m²/100 lx	-	-	

3.4 Lighting for shops:

Shops are the most important element in the mall, so its lighting must be bright and attractive in order to improve the sale process.

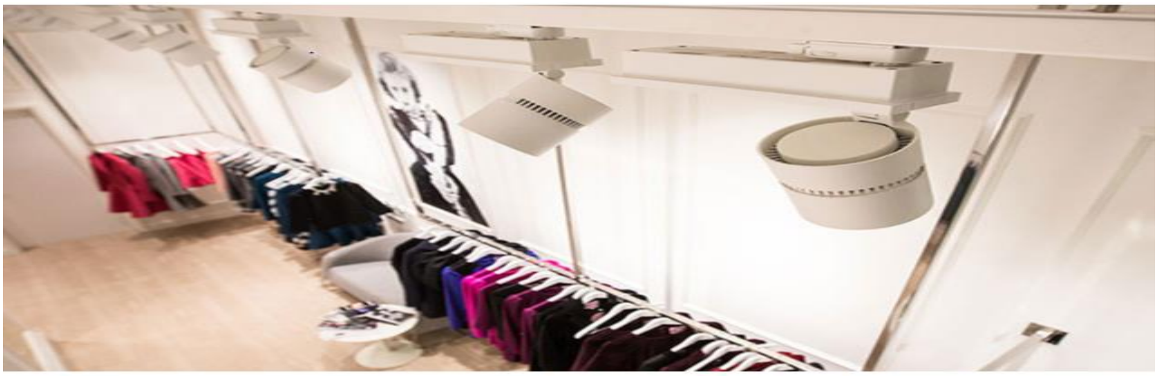


Figure3.5 : Lighting in the shop

Table 3.3 :Luminescent requirements in shops and play area

	Maintained illuminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	(Maintenance Factor	Height of working plan
Shops	500	19	80	5000	0.8	0.8
Play area	200	22	80	3500	0.8	0
Stores	100	25	60	3000	0.8	0.8

TrueFashion are used in shop , This type of use in the shops gives a bright and attractive lighting.

Figure3.6 : TrueFashion lamp

The mall consists of a variety of stores, including clothes, shoes, children's toys, sweets, etc ….
The following table shows the results for the toys shop

Table3.4 : lighting result in toys shop

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	523 lx	≥ 500 lx	✓	S32
	g_1	0.027	-	-	S32
Consumption values	Consumption	[1150 - 1800] kWh/a	max. 3600 kWh/a	✓	
Lighting power density	Room	6.45 W/m²	-	-	
		1.23 W/m²/100 lx	-	-	

Utilisation profile: Offices, CAD workplaces

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
23	PHILIPS		ST715T 1 xLED27S/PC930 FPO24	28.5 W	2488 lm	87.3 lm/W

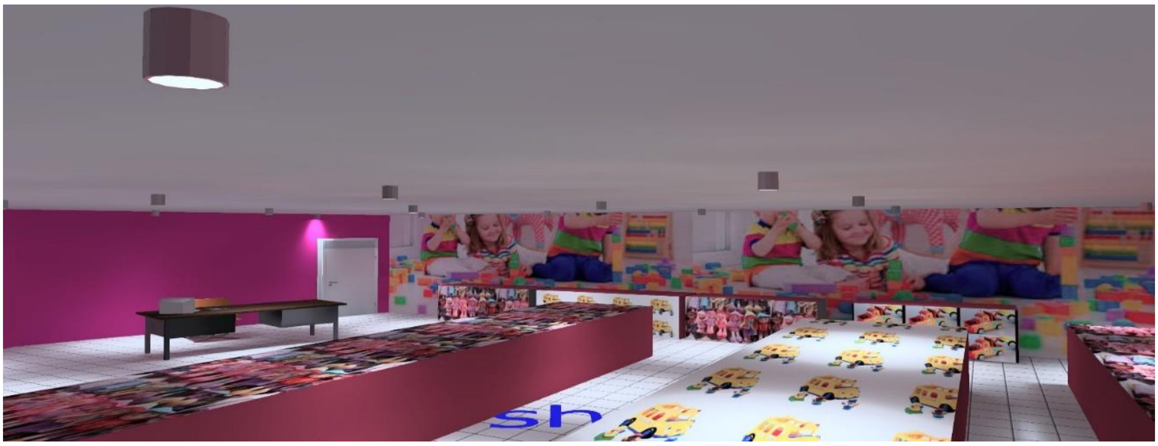


Figure 3.7: lighting in toys shop 3D

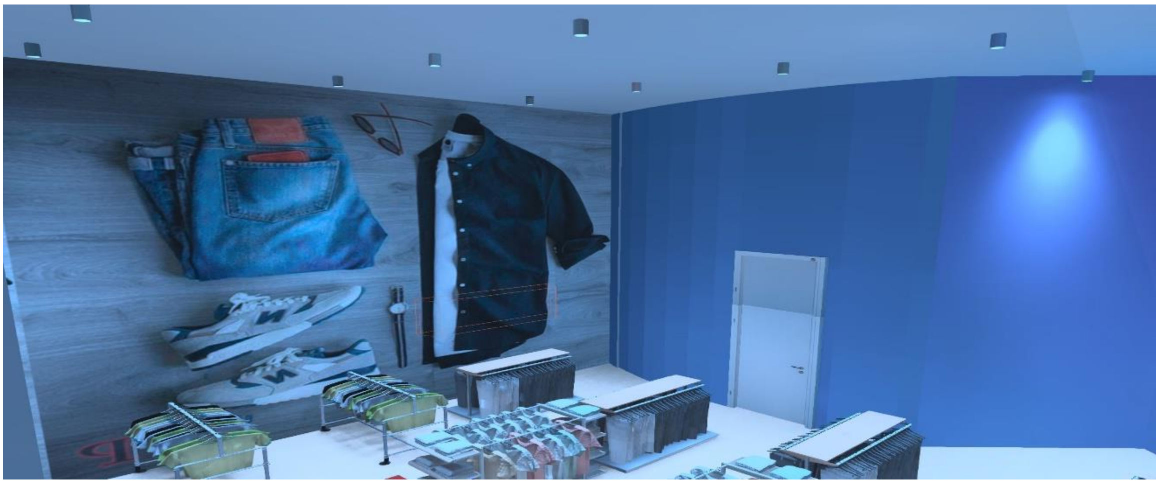


Figure 3.8: lighting in men clothes shop 3D

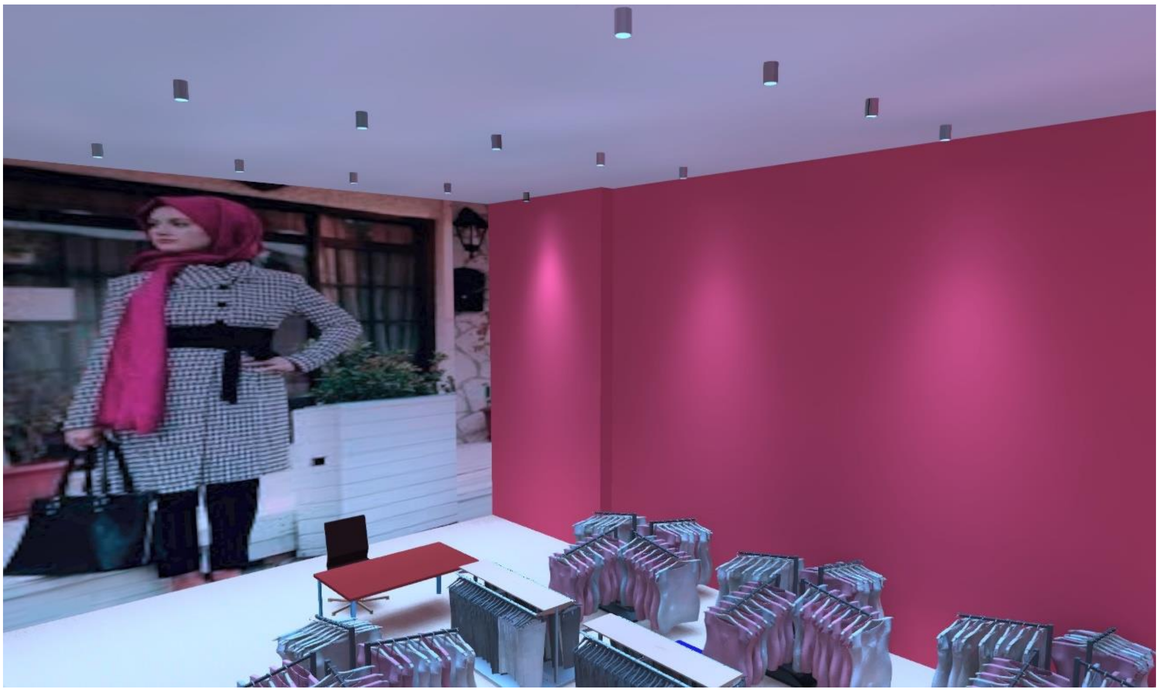


Figure3.9 : lighting in women clothes shop 3D

3.5 Lighting for Play area :

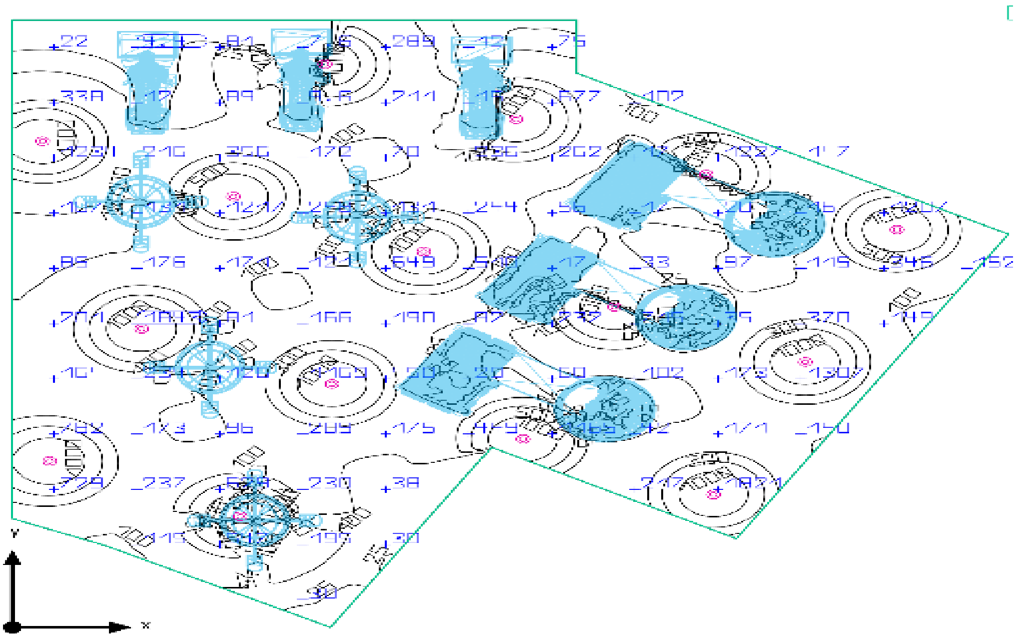


Figure3.10: the distribution of luminous flux for play area

Table 3.4 : the calculation results for play area

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	107 lx	≥ 100 lx	✓	S10
	g_1	0.57	-	-	S10
Consumption values	Consumption	3 kWh/a	max. 900 kWh/a	✓	
Lighting power density	Room	0.72 W/m²	-	-	
		0.67 W/m²/100 lx	-	-	

Utilisation profile: General areas inside buildings - Store rooms and cold stores, Store and stockrooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	PHILIPS		DN460B PSD-VLC-E P 1 xLED115/840 C P	9.0 W	1124 lm	124.9 lm/W

Figure3.12 : lighting in men play area 3D

Figure3.13 : lighting in play area 3D

3.6 Lighting for restaurant and café :

The fourth floor of the mall contains a restaurant and a, therefore low lighting is designed to create a comfortable mood and relax for customers inside the café and restaurant.

The following table shows the appropriate characteristic values for each part of the restaurant

Table3.5 : Luminescent requirements in restaurant

	Maintained illuminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	(Maintenance Factor	Height of working plan
Reception	300	22	80	3500	0.8	0.8
Kitchen	500	22	80	2700	0.8	0.8
dining room	100	22	80	3000	0.8	0.8
Corridors	100	28	80	3500	0.8	0

Corridor :

For corridor lighting a LuxSpace Accent were used , as shown in figure

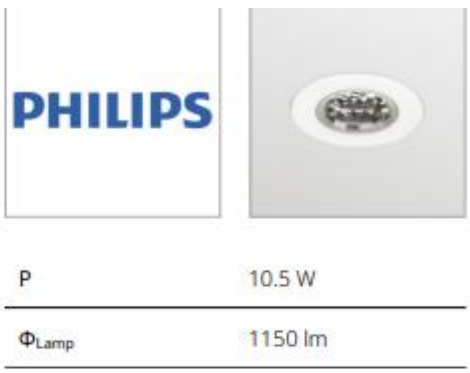


Figure 3.14: LuxSpace Accent

And The result as following :

Table 3.6 : the calculation results for corridors

Summary

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$E_{perpendicular}$	156 lx	≥ 100 lx	✓	S30
	g_1	0.16	-	-	S30
Consumption values	Consumption	48 kWh/a	max. 1200 kWh/a	✓	
Lighting power density	Room	1.29 W/m²	-	-	
		0.83 W/m²/100 lx	-	-	

Utilisation profile: Traffic zones inside buildings, Circulation areas and corridors

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	PHILIPS		RS342B 1 xLED17S/827 MB	14.4 W	1648 lm	114.5 lm/W

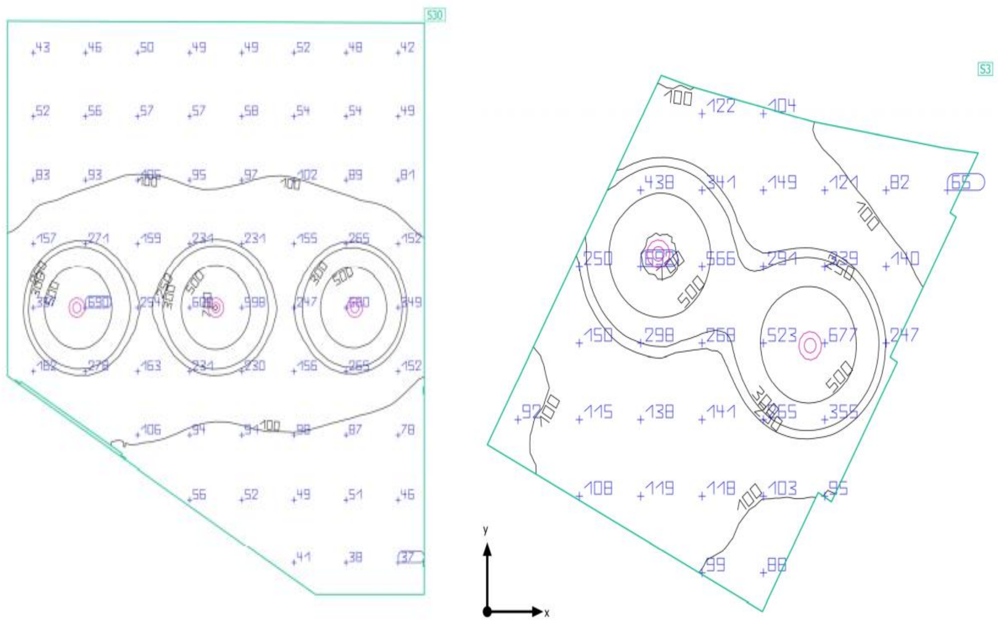


Figure3.15: the distribution of luminous flux for carridors

Kitchens :

For the kitchens, a type of PacificLED gen4 lighting unit was chosen , highly efficient and reliable LED waterproof luminaire that offers an excellent quality of light, with a uniform light distribution without visible striping or color artefacts. The range offers modular construction to enable ease of upgrade and maintenance.

P	46.5 W
Φ_{Lamp}	6400 lm
$\Phi_{Luminaire}$	6401 lm
η	100.02 %
Luminous efficacy	137.7 lm/W

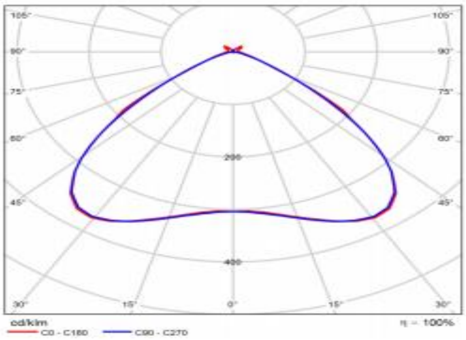


Figure 3.16 : Pacific LED gen4

P_{total}	A_{Room}	Lighting power density	$\bar{E}_{perpendicular\ (Workplane)}$
139.5 W	30.00 m²	4.65 W/m² = 0.94 W/m²/100 lx (Room)	497 lx

Figure 3.17: the total power in kitchen 1

Table 3.7 : the calculation results for kitchen 1

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	497 lx	≥ 500 lx		S22
	g_1	0.002	-	-	S22
Consumption values	Consumption	[410 - 540] kWh/a	max. 1100 kWh/a	✓	
Lighting power density	Room	4.65 W/m²	-	-	
		0.94 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Kitchens

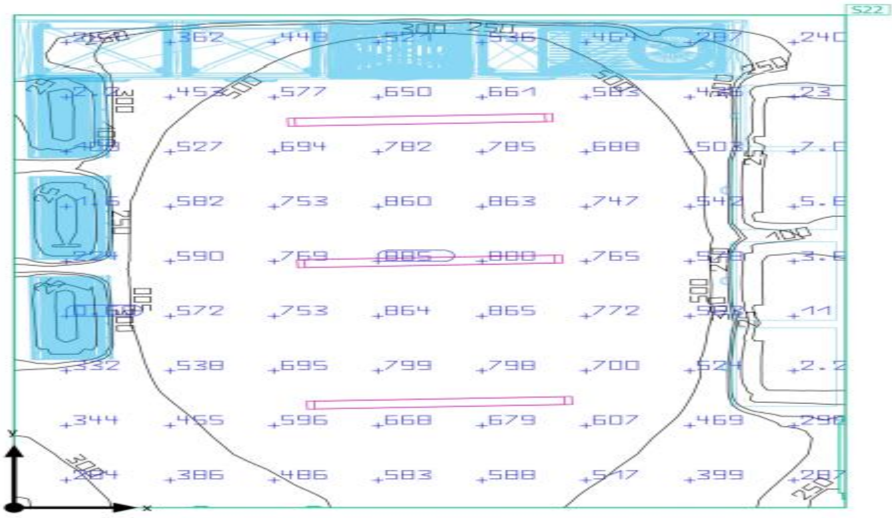


Figure3.18: the distribution of luminous flux for kitchen 1

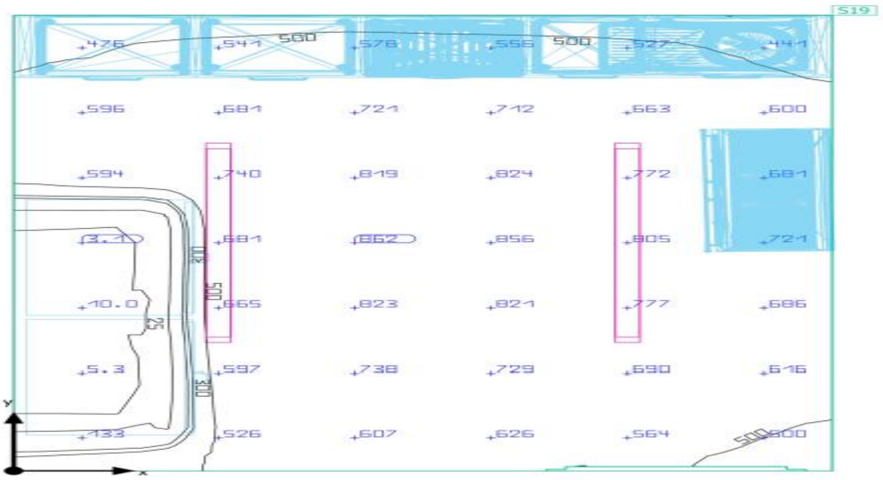


Figure3.19: the distribution of luminous flux for kitchen 2

Table3.8 : the calculation results for kitchen 2

Summary

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	591 lx	≥ 500 lx	✓	S19
	g_1	0.002	-	-	S19
Consumption values	Consumption	[270 - 360] kWh/a	max. 450 kWh/a	✓	
Lighting power density	Room	7.98 W/m²	-	-	
		1.35 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Kitchens

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	PHILIPS		WT470X L1600 1 xLED64S/840 WB	46.5 W	6401 lm	137.7 lm/W

Reception and dinning area :

PHILIPS RS342B 1 xLED17S/827 MB

PHILIPS

P	14.4 W
Φ_{Lamp}	1650 lm
$\Phi_{Luminaire}$	1648 lm
η	99.89 %
Luminous efficacy	114.5 lm/W

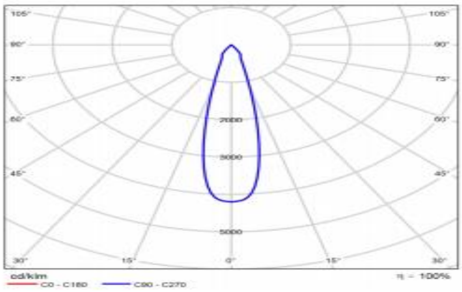


Figure3.20 : Green Space Accent Elbow

For food retailers, GreenSpace Accent Elbow comes with special light recipes to enhance the store ambiance and show the produce in the very best light: Fresh Food Champagne is the perfect solution for displaying fruit, vegetables, cheese, bread and pastries in a warm lighting ambiance, while Fresh Food Meat creates the best light setting for meat enhancement in a cool natural ambiance.

Figure3.21: the distribution of luminous flux for reception

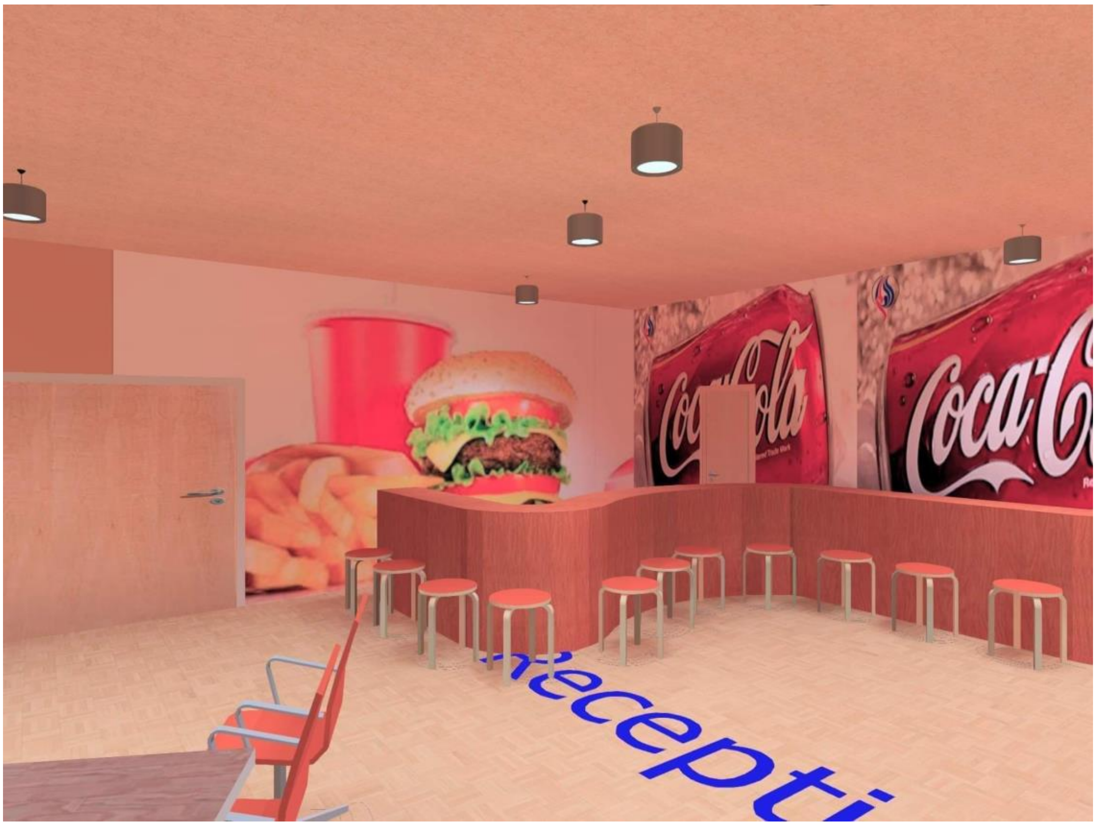


Figure3.22 : lighting in reception 3D

Table3.9 : the calculation results for reception

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	314 lx	≥ 300 lx	✓	S24
	g_1	0.038	-	-	S24
Consumption values	Consumption	830 kWh/a	max. 2550 kWh/a	✓	
Lighting power density	Room	3.19 W/m²	-	-	
		1.02 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Reception/cashier desk, porter's desk

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
16	PHILIPS		RS342B 1 xLED17S/827 MB	14.4 W	1648 lm	114.5 lm/W

Family area :

general dinning area :

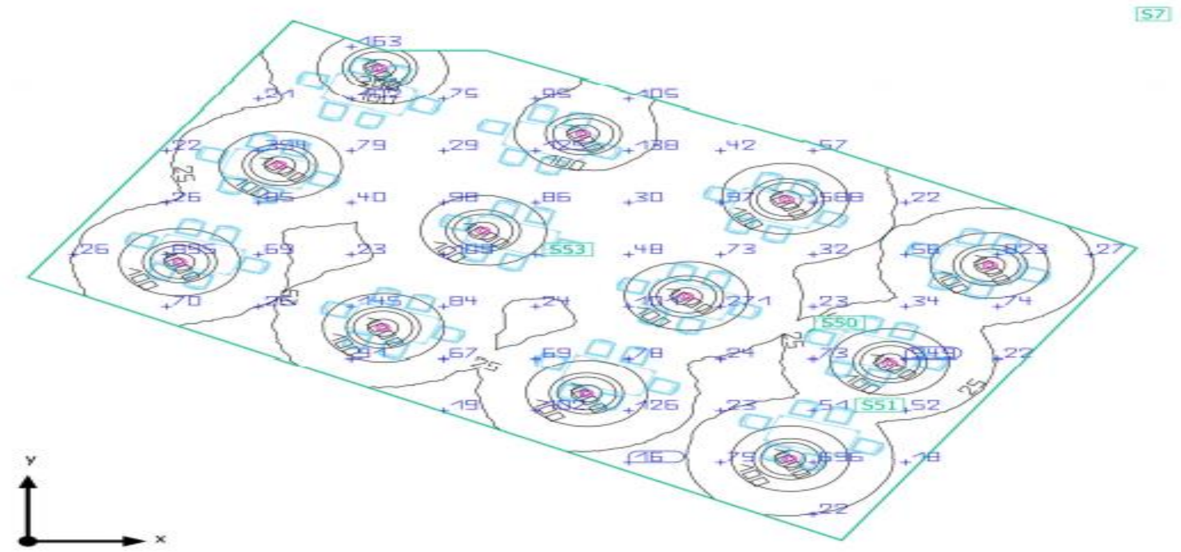


Figure3.23: the distribution of luminous flux for family area

Table3.10 : the calculation results for family area

Summary

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	126 lx	≥ 100 lx	✓	S7
	g_1	0.098	-	-	S7
Consumption values	Consumption	[510 - 670] kWh/a	max. 5200 kWh/a	✓	
Lighting power density	Room	1.17 W/m²	-	-	
		0.93 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Restaurants, dining rooms, function rooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
12	PHILIPS		RS342B 1 xLED17S/827 MB	14.4 W	1648 lm	114.5 lm/W

general dinning area :

Table3.11 : the calculation results for family area

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	112 lx	≥ 100 lx	✓	S9
	g_1	0.097	-	-	S9
Consumption values	Consumption	[210 - 280] kWh/a	max. 2300 kWh/a	✓	
Lighting power density	Room	1.12 W/m²	-	-	
		1.00 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Restaurants, dining rooms, function rooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
5	PHILIPS		RS342B 1 xLED17S/827 MB	14.4 W	1648 lm	114.5 lm/W

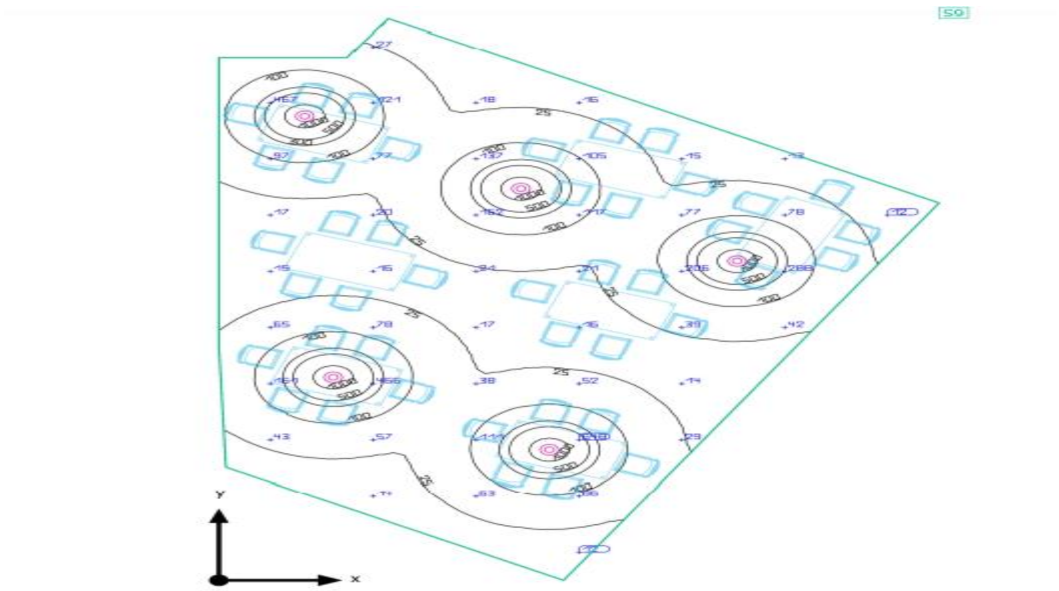


Figure3.24: the distribution of luminous flux for dinning area

café :

The café is one of the most important places in which the lighting must be taken care of, as it must provide comfortable lighting that causes relaxation and tranquility.

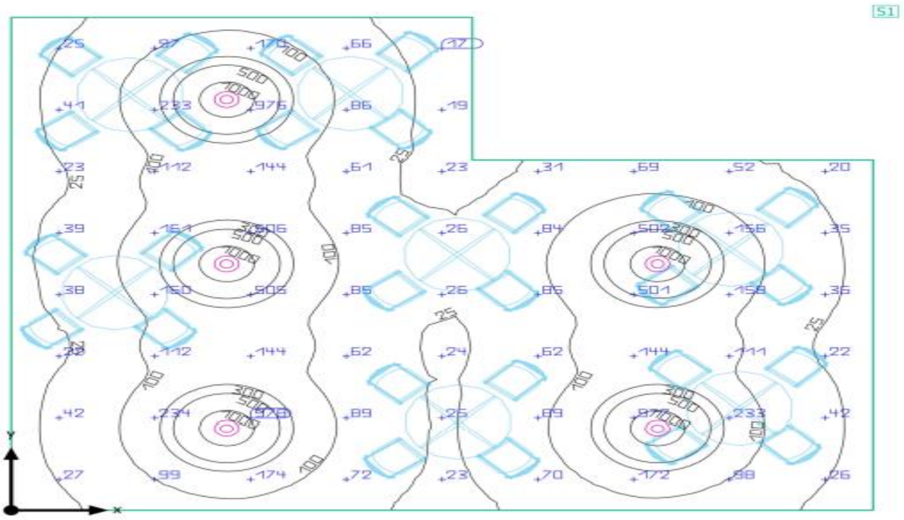


Figure3.25 :the distribution of luminous flux for a part of café

Table3.12 : the calculation results for a part of café

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	153 lx	≥ 100 lx	✓	S1
	g_1	0.10	-	-	S1
Consumption values	Consumption	280 kWh/a	max. 1650 kWh/a	✓	
Lighting power density	Room	1.53 W/m²	-	-	
		1.00 W/m²/100 lx	-	-	

Utilisation profile: Places of public assembly - Restaurants and hotels, Restaurants, dining rooms, function rooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
5	PHILIPS		RS342B 1 xLED17S/827 MB	14.4 W	1648 lm	114.5 lm/W

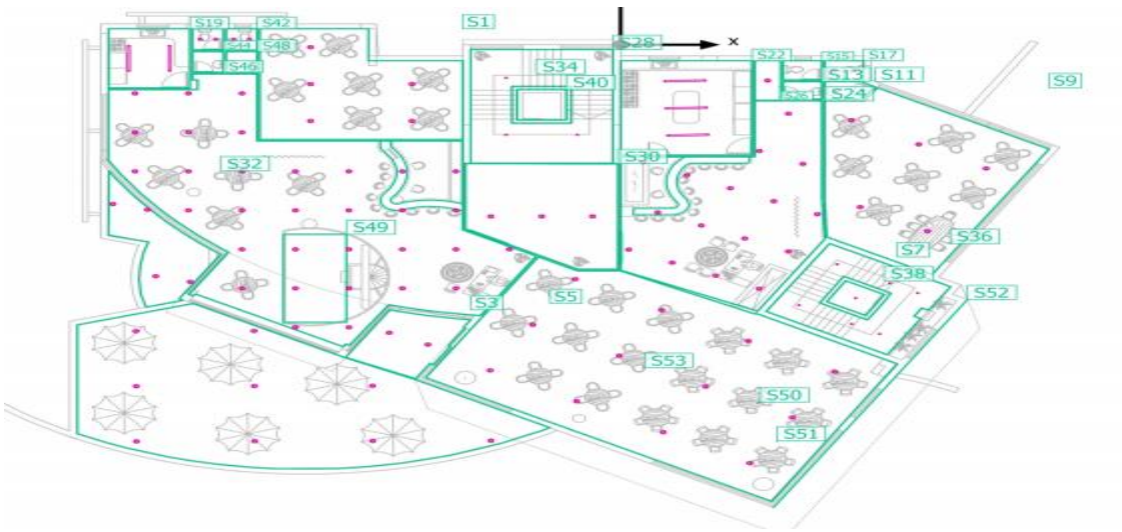


Figure3.26 : The distribution of Lighting units in restaurant and café

3.7 Lighting for clinics

In general, the lighting is designed for clinics so that the lighting is homogeneous and comfortable, provides good vision and eye safety, and the lighting units must be of high quality and do not cause a flash that disturbs patients.

Table3.13 : Luminescent requirements in Clinic

	Maintained illuminance (lux)	Limiting glare rating	Minimum color rendering (Ra)	Color Temperature	(Maintenance Factor	Height of working plan
Clinic (general lighting)	500	19	90	5000	0.8	0.8

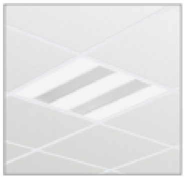
Waiting area	200	22	80	3500	0.8	0.8
Office	100	19	80	4000	0.8	0.8

Waiting area :

For waiting rooms, general lighting is used with lamps directed down and does not cause dazzling , with CRI not less than 80 and CCT 3500K. FlexBlend Was selected from PHILIPS , its High quality and 50% energy saving

PHILIPS RC340B SRD W60L60 1 xLED36S/930 MLO

PHILIPS



P	38.5 W
Φ_{Lamp}	3600 lm
$\Phi_{Luminaire}$	3598 lm
η	99.94 %
Luminous efficacy	93.4 lm/W
CCT	3000 K

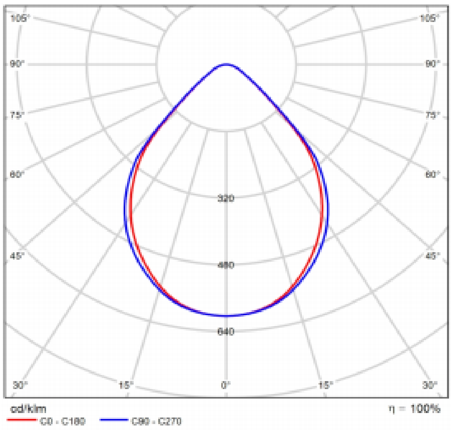


Figure 3.27 : Flex Blend

The total power consumption by lighting and the lighting power density as following :

P_{total}	A_{Room}	Lighting power density	$\bar{E}_{perpendicular (Workplane)}$
115.5 W	36.20 m²	3.19 W/m² = 1.37 W/m²/100 lx (Room)	232 lx

The following image shows the distribution of luminous flux in the waiting room, this distribution achieves average luminous flux 232 lx

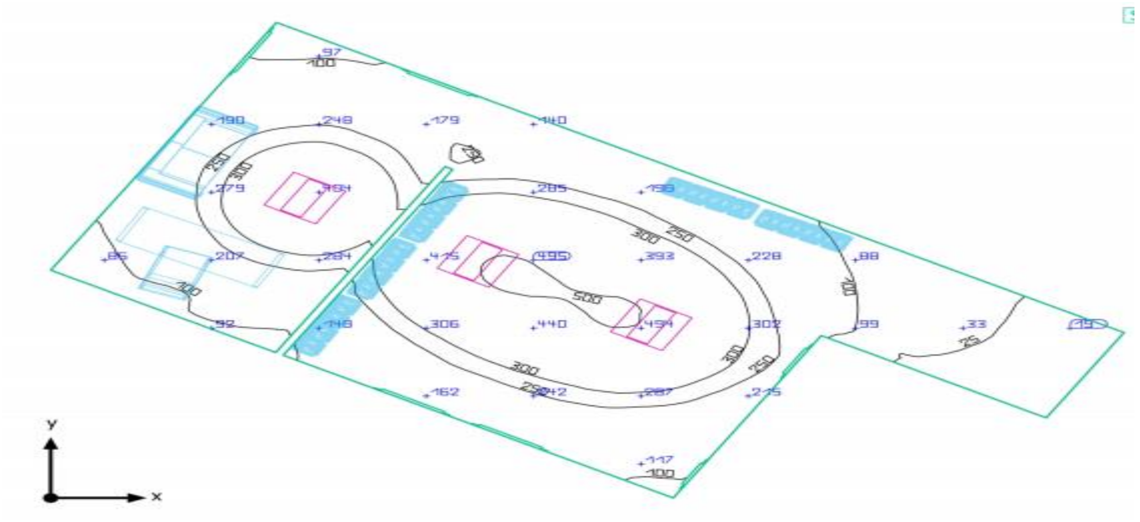


Figure 3.28 :the distribution of luminous flux for waiting area

The following table illustrates luminous flux , So as to achieve the required light for the waiting room, It is also shown the lighting power density.

Table3.14 : the calculation results for waiting area

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	232 lx	≥ 200 lx	✓	S28
	g_1	0.056	-	-	S28
Consumption values	Consumption	220 kWh/a	max. 1300 kWh/a	✓	
Lighting power density	Room	3.19 W/m²	-	-	
		1.37 W/m²/100 lx	-	-	

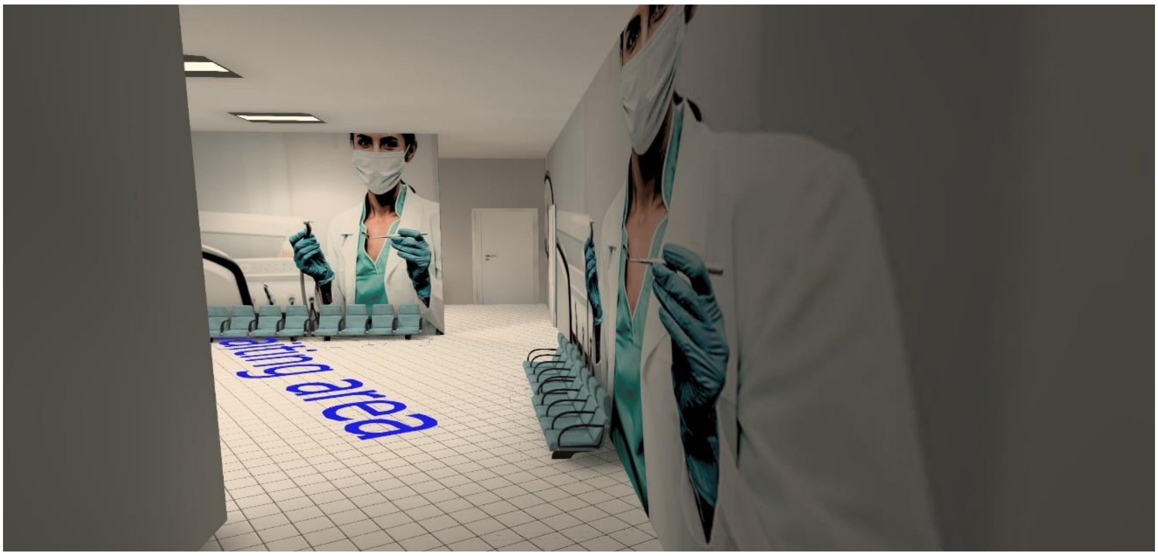


Figure3.29: Lighting design for waiting area 3D

Clinics

There are 5 different clinics in the mall , The luminaires of CoreLine Recessed Spot were chosen .it's high-quality luminaires. CoreLine Recessed Spot is a recessed spot range designed to replace halogen-based luminaires. This product provides a natural lighting effect for accent lighting applications.

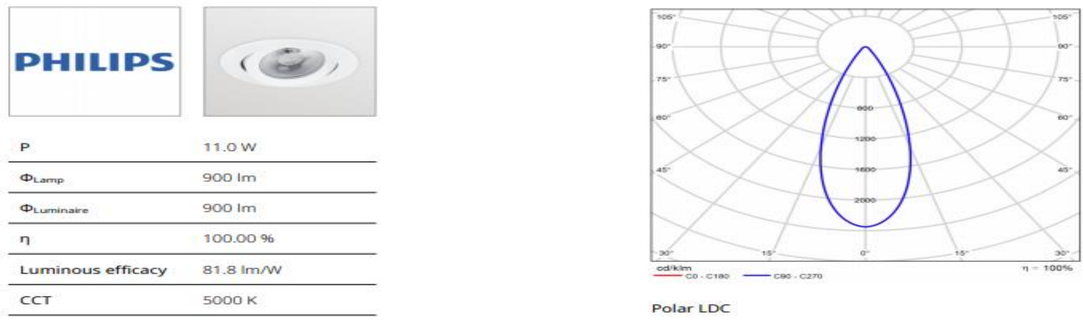


Figure3.30 : CoreLine Recessed Spot luminaire

The following table shows the number of lighting units and the total power for each clinic

Table3.15 : Total power for clinics

	Ptotal	ARoom	Lighting power density	Ēperpendicular (Workplane)	pcs.
office	49.0 W	6.69 m²	7.32 W/m² = 1.46 W/m²/100 lx (Room)	502 lx	2
Clinic1	165 W	30.36 m²	4.62 W/m² = 0.92 W/m²/100 lx (Room)	501 lx	15
Clinic2	132 W	13.13m²	10.05 W/m² = 1.64 W/m²/100 lx (Room)	613 lx	12
Clinic3	165.0 W	22.18 m²	7.44 W/m² = 1.39 W/m²/100 lx (Room)	535 lx	15

Clinic4	132W	15.63 m²	8.44 W/m² = 1.58 W/m²/100 lx (Room)	536 lx	12
Clinic 5	165W	16.43 m²	10.04 W/m² = 1.71 W/m²/100 lx (Room)	586 lx	15

The following image shows the distribution of luminous flux in the waiting room

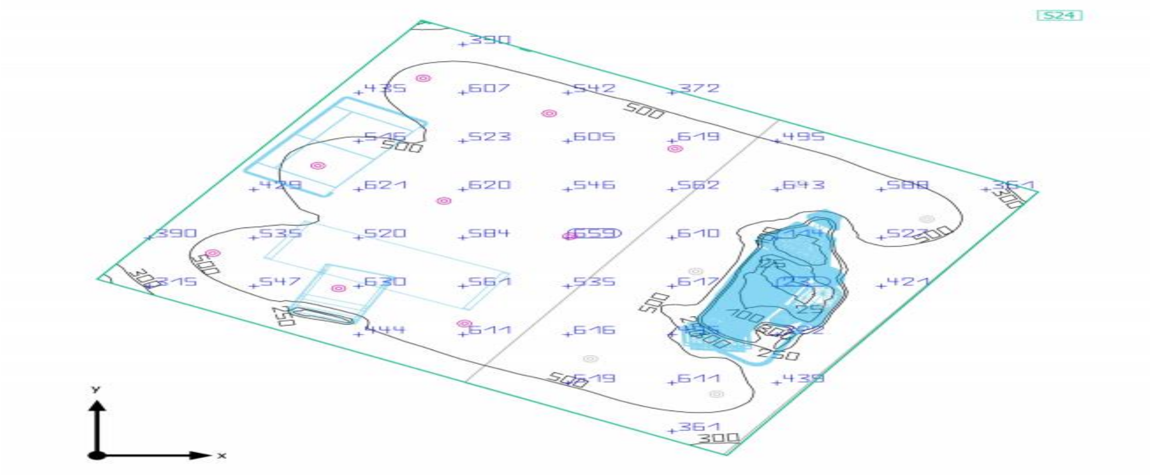


Figure3.31 : The distribution of luminous flux for clinic

And this picture shows the lighting design of a 3D clinic

Figure3.32 : Lighting design for clinic 3D

3.8 Lighting for offices

The mall contains 3 floors (seventh, eighth and ninth) containing various offices.And the design of lighting for them needs attention to achieve the desired goal.

Table 3.16 : Luminescent requirements in office

	Maintained illuminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	(Maintenance Factor	Height of working plan
Office	500	19	80	4000	0.8	0.8
Meeting room	500	19	80	4000	0.8	0.8
Waiting area	200	22	80	3000	0.8	0.8

In offices , Lamps with general square lighting to give a general lighting of the place (preferably with high efficiency), in this offices a PowerBalance gen2 from Philips were used . unstainable performance When it comes to lighting an office space with LED luminaires that Provides a comfortable working environment.

PHILIPS

P	24.5 W
Φ_{Lamp}	4000 lm

Figure 3.33 : Power Balance gen2

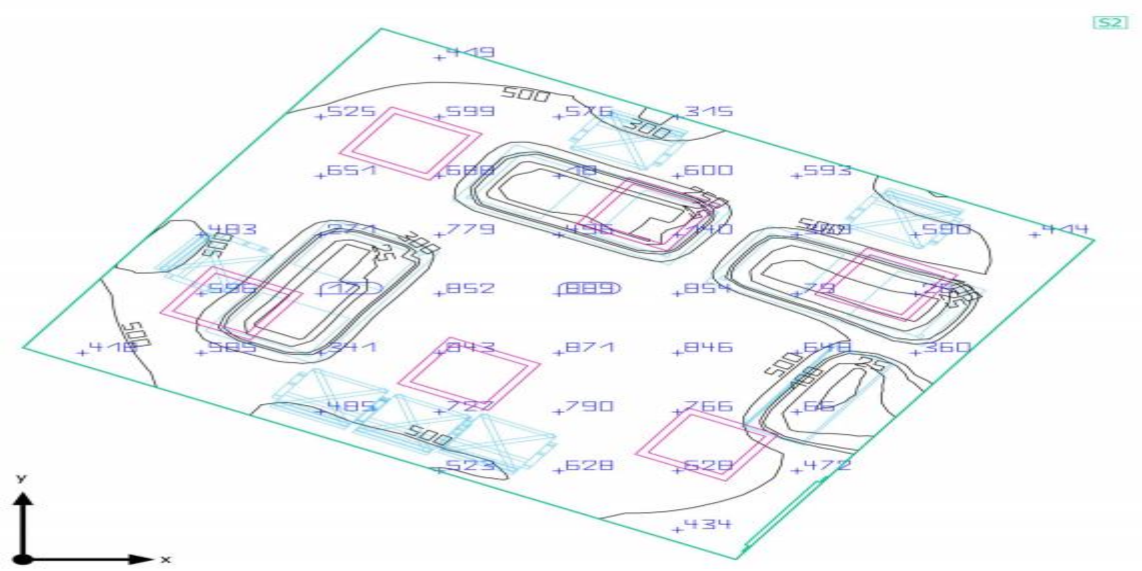


Figure 3.34 : The distribution of luminous flux for office

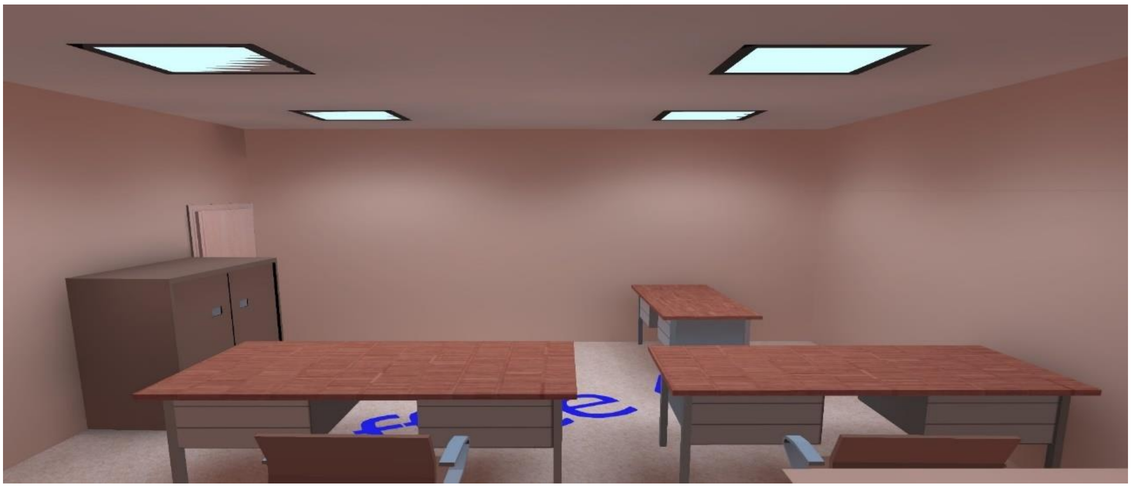


Figure3.35 : Lighting design for office 3D

Waiting area

For waiting area GreenSpace – high-efficiency was chosen , low power consumption, while delivering consistent light output, stable color performance and high color rendering.

PHILIPS

P	16.2 W
Φ_{Lamp}	2200 lm

Figure3.36 : GreenSpace

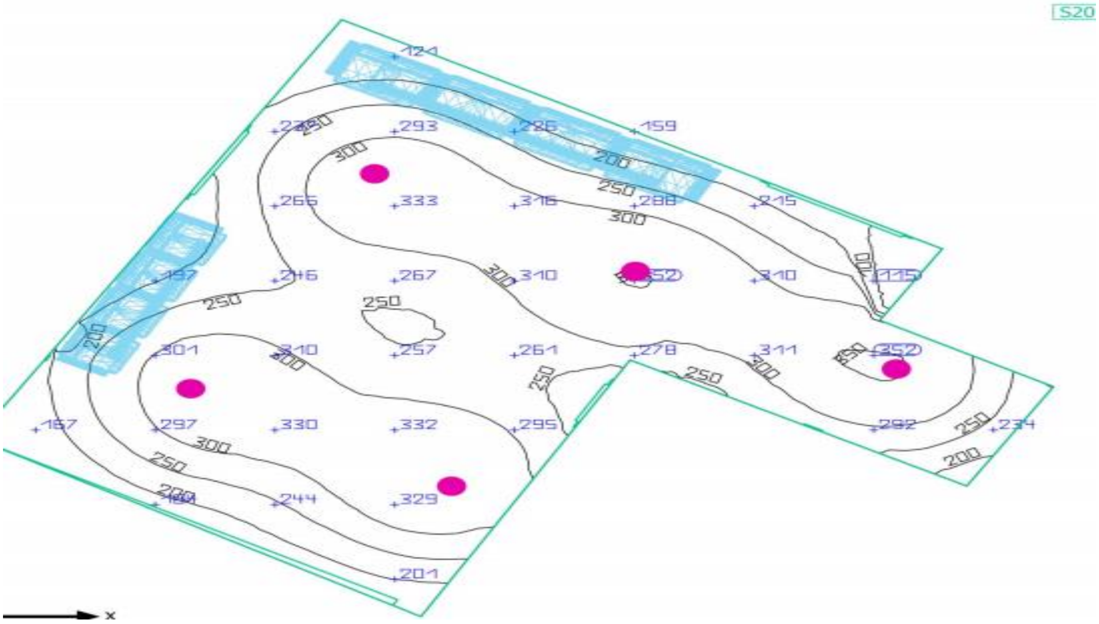


Figure3.37 : The distribution of luminous flux for waiting area

Figure3.38 : The distribution of Lighting units in Eighth floor

3.9 Emergency lighting

Public buildings are provided with an emergency lighting system that allows people to evacuate quickly and safely through escape corridors. And emergency lighting works automatically when the power is separated from the building

- **Direction and exit signals**

Escape corridors are provided with directional signs to direct people to the exit doors

Figure3.39 : Emergency lighting device with directional signal

Figure3.40 : Emergency lighting device with an output signal

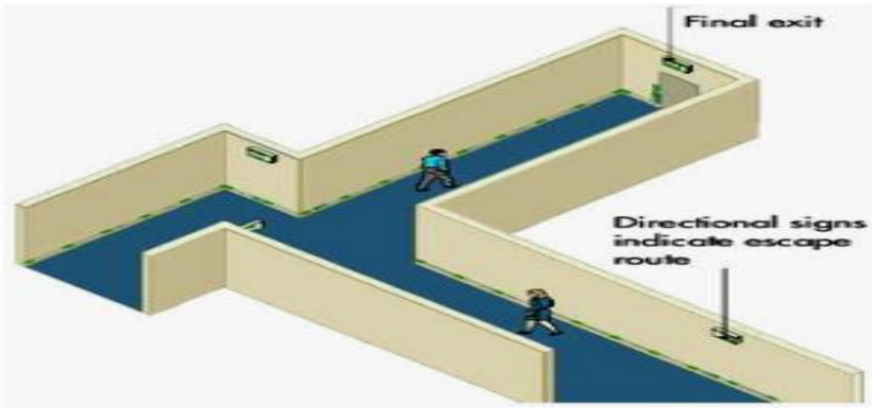


Figure3.41 : Sites of emergency lighting devices

- **Illumination escape**

Illumination of escape corridors, corridors, stairs and fire inserts

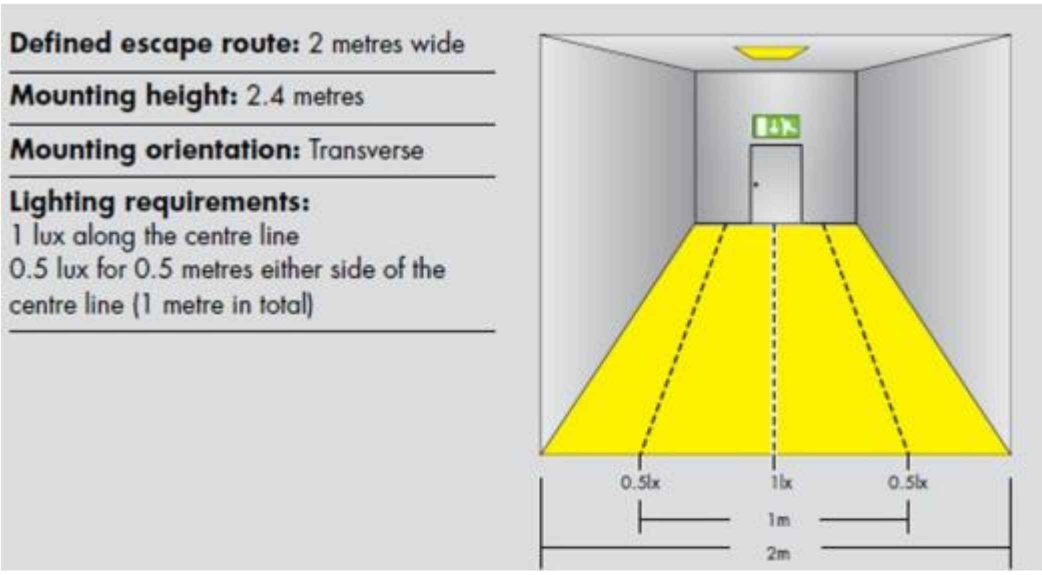


Figure3.42 : Specifications of emergency lighting unit

Emergency lighting system design

The first stage : Exit Signals

The second stage is : mandatory points

Emergency lighting devices must be installed at specific mandatory points on the escape pathways in order to give the necessary light

These include points

1. At every lane intersection
2. Each door has an exit
3. When every change of direction
4. At every stair so that it is directly lit by lighting
5. At every change in the level of the floor
6. Outside and near every final exit
7. When fighting fire equipment
8. Escalators to enable users to descend safely
9. Control rooms

Legend of lighting fixtures

Lighting fixtures description must include the following:

1. Lamp type.
2. Luminaire wattage.
3. IP.
4. Mounting type.
5. Optical cover.

CHAPTER 4

Power Design

4.1 overview

4.2 sockets and its types

4.3 Step of designing of power plan

4.4 Electrical requirement for AC

4.1 Overview :

This chapter about power desighm that include , type of socket, and AC system.Also sample og design power system

4.2 sockets and its types

At power design, we are committed to providing a quality product and excellent customer service. While our growth is a part of our culture, business decisions are made based on long- term relationships and commitment, not profit margins. Partnering with power design means having a team member on board that seeks to create successful, innovative projects, delivered on time and on budget.

Every device in the building need sockets and switching method to control it.

Types of sockets :

1. Single Socket

Figure4.1: Single Socket

2. Double Socket:

Figure4.2 :Double Socket

3. UPS Socket:

Figure4.3. : UPS Socket

4. Water Proof Socket:

Figure4.4. :Water proof Socket

5. Floor Box:

Figure4.5 :Floor Box

6. 20 A socket for AC

Figure4.6 :AC socket

4.3 The steps of designing the sockets plan

The sockets are distributed on the plans that contain the furniture after receiving them from the architect in the appropriate numbers for each load so that they cover all the facades so as not to conflict with the furniture

1. A normal electric socket and a double ups socket next to the computer desk
2. Electric socket for the TV next to the TV site
3. Waterproof sockets in kitchens and washing rooms
4. Celling socket for projector
5. Connect every 3 or 4 normal sockets in one circuit breaker 16A
6. Connect every 3 or 4 UPS sockets in one circuit breaker 16A
7. Connect AC socket in one circuit breaker
8. Connect 3 phase socket on 3 phase circuit breaker

HVAC Load :

4.4 Electrical requirements for Air-Conditioning and refrigeration equipment

NEC Article 440 provides the requirements for installing air-conditioning and refrigeration equipment that involves one or more hermetic refrigerant motor-compressors. Where these compressors are not involved, The data furnished on the nameplate with this air-conditioning unit supply the information in Figure 3.4.2 Most everything the electrician needs to know about the wiring of the HVAC equipment is provided on the nameplate.**[8]**

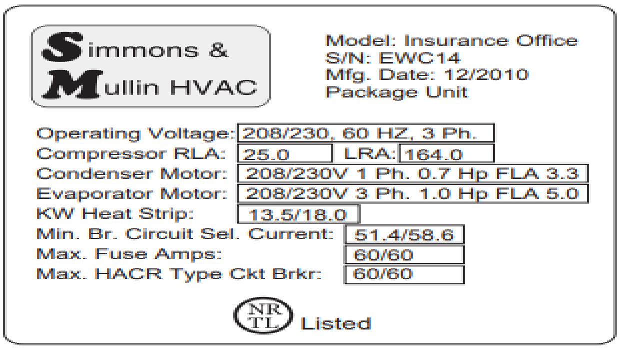


Figure 4.7: Nameplate of HVAC.[8]

The one ton AC = 3.52KW , but the split unit AC work in average 8 hours in day , i.e
In 33% (8/24), so the total power from 1ton =1.2kw
And every 15 m^2 need 1TON

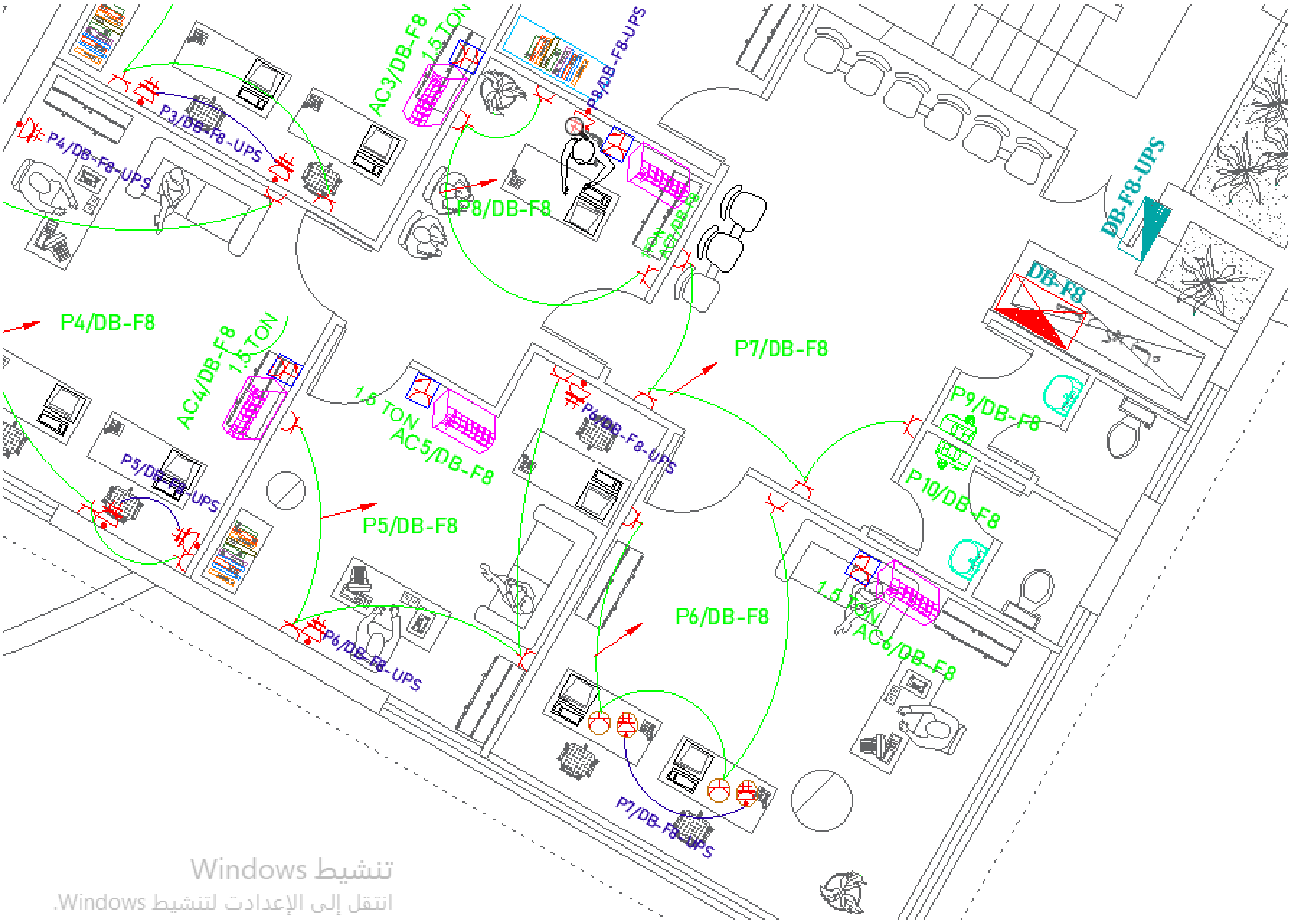


Figure 4.7: sample from the project power

CHAPTER 5

Load Calculation

5.1 Overview

This chapter about load caculation , include load for evey type, circuit breakers , cable , voltage drop , power factor correction and distribution boared

5.2 load calculations

Luminous loads according to the capacity of each bulb

Socket loads 250 watts per one

AC load , every 1 Ton = 3.5KW, but AC works an average of 8 hours a day i.e 33% so 1Ton= 1.2KW, and every 15 m^2 need 1 Ton

The loads were distributed among the three phases so that the three phases were balanced

5.3 Circuit Breakers (CB)

In NEC Article 100, a circuit breaker is defined as " device that is designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without being damaged itself when properly applied within its rating " **.[8][13]**

The specifications of the CB are determined by two important values:

- **Rated Current (I_{rated}) (measured by ampere A):** it determines the value of the maximum current that can flow into the CB continuously without causing the CB to cut off**.[1]**

- **Short Circuit Capacity (SCC) (measured by KA) :** It is the maximum value of the current that a CB can endure during short circuit without burning**[1]**

  The most famous values of (SCC) are: 3,6,10,15,22,35,50,75,80,100

Types of circuit breakers:

I. Miniature Circuit Breakers (MCB)

Molded-case circuit breakers are the most common type in use today,

Figure5.1: MCB[1]

Table 5.1 : Type characteristics of circuit breakers.**[7]**

CB type	Tripping Current (factor to be multiplied by nominal rating)	Typical application
1	**2.7 to 4**	Domestic and where overload surges are not anticipated
B	**3 to5**	General purpose and commercial
2	**4 to 5**	General purpose and commercial
3	**7 to 10**	Motors and highly inductive discharge lighting
C	**5 to 10**	Motors and highly inductive discharge lighting
4	**10 to 50**	Only for special conditions ,e.g. some welding plant
D	**10 to 20**	Only for special conditions ,e.g. some welding plant

. A Type B CB is usually a suitable standard choice for most domestic and commercial installations, but this depends on the earth loop impedance.**[7]**

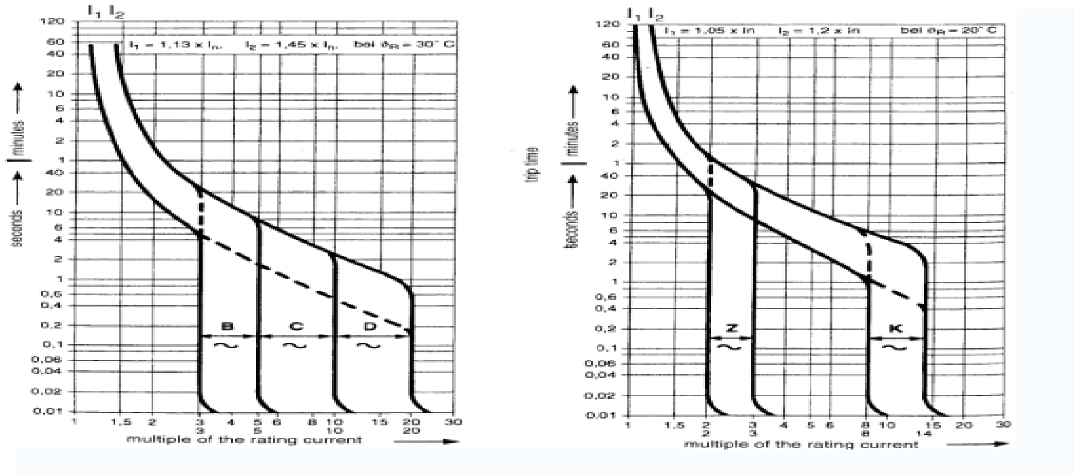


Figure 5.2: Circuit breakers curve.**[8]**

II. Molded Case Circuit Breaker (MCCB)

These circuit breakers are mainly used for 3-phase circuits and for currents larger than 100A and up to 1600A.**[1]**

Figure 5.3: MCCB types **[1]**

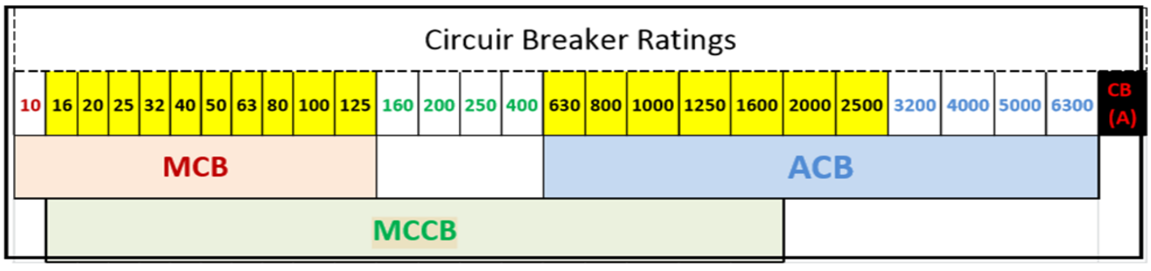


Figure 5.4: circuit braker rating **[1]**

III. Ground Fault Circuit Breaker (GFCB)

It is used to protect against the current leakage to the ground in electrical installations

The principle of its work: it compares the current entering and leaving the circuit, if there is a difference in the current, this indicates the occurrence of a leakage current**.[1]**

Figure 5.5 Earth Leakage CB **[1]**

Circuit Breaker and wire size determination:

Circuit breakers come in standard sizes, so part of the project research is to determine the standard sizes available in the region. To select a breaker, one adds a factor of 25% (to avoid nuisance tripping) and then chooses the next higher size available**.[1][11]**

3.1.1 Cables and their installations methods

The most important principle in dealing with cables is safety. In order to achieve this principle, the cables were distinguished by special specifications related to the ampere capacity and methods of cable installations

It is worth noting that the term cable is used for the main feeders, while the term wire used in branch circuits**.[3]**

Several factors influence cable selection:[1][3]

1) Maximum operating voltage
2) Maximum load
3) Maximum overload and maximum time for it

4) Maximum short circuit and maximum time for it
5) Insulation level
6) Cable length
7) Voltage drops
8) Cable extension method
9) The lower and the greater the temperature the cable is exposed to
10) Soil physical and chemical specifications.

5.4 Cables installations methods:

The method of laying the cables depends on several factors, the most important of which is the nature of the project.

1. **Raceway**

The term raceway is defined by the NEC as a channel that is designed and used expressly for the purpose of holding wires, cables, or busbars**.[8][13]**

It is made of plastic or metal; it has a cover that can be opened. It is characterized by the easy of changing the circuits within it. Some types are underground, especially in offices.
It is often used over walls because there are many varied sockets that include electrical sockets, phones sockets, the Internet sockets and others.

They are frequently used with computer devices because they need various sockets, buried ground pipes are useless with it**.[1]**

Figure 5.6: Raceway[1]

2. **Conduit**

A separate classification of rigid conduit (NEC Article 347) covers raceways that are formed from such materials as fiber, asbestos–cement (not as serious an environmental concern as it might sound), soapstone, rigid polyvinyl chloride (PVC), and high-density polyethylene**.[7][13]**

The purpose of conduit is to:

1. Protect the enclosed wiring from mechanical injury and damage from the surrounding
atmosphere
2. Provide a grounded metal enclosure for the
wiring in order to avoid a shock hazard
3. Provide a system ground path
4. Protect surroundings against a fire hazard as a
result of overheating or arcing of the enclosed
conductors
5. Support the conductors**[7]**

Classification of cables based on insulation:

Cables used in Installation   the insulating materials are:

1. **PVC:** It has excellent electrical properties at low voltages (up to 3.3 kv) and at low temperatures, in addition its cheap price**.[1][7]**
   Not suitable in high temperatures, it can only withstand up to 70°C. **[3][4]**

2. **XLPE:** It has high humidity resistance, withstands overloads and short circuit conditions. withstands high temperatures up to
90°C. **[3][4][7].**

Current Carrying Capacity:

It is the wire's ability to pass the load current under normal operating conditions and its ability to withstand the currents resulting from faults**.[3]**

The most important determining factors of Current carrying capacity:

1. Temperature
2. The type of material of the conductor
3. The number of cables inside the tube.
4. Cable extension method(this is due to temperature difference because the cable generates heat as a result of the passage of a current through it, and if the rate of heat expulsion is greater than its generation, then the value of the current passing through the cable may increase) **.[1][3][4]**

Steps for determining the appropriate cable section:[3]

1. Determine the maximum load current of a circuit. I_l
2. Determine the current set for the appropriate protection of the circuit, so that it is greater or equal to the maximum load current

$I_{CB} > 1.25\ I_l$

3. Determine the cable installation method, the number of adjacent cables, and the ambient temperature to find out the De-rating factors (K)
4. Determine the permissible current in the circuit that is proportional to the section of the cable protected by the breaker so that $I_z > I_n$

5. The current I_z is divided by the correction factors and the resulting current is the current based on which the cable section is chosen

   ${I_z}^*$

This table to choosing suitable cross section area after calculation

Table 5.2: cross section area for cables

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 70 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
1.5	rm	12.1000	14.4777	27	19	21	9.9	145	C208PA10200CB01IMR
2.5	rm	7.4100	8.8661	36	24	28	10.8	185	C210PA10200CB01IMR
4	rm	4.6100	5.5159	47	32	38	12.7	260	C212PA10200CB01IMR
6	rm	3.0800	3.6853	58	40	48	13.8	330	C213PA10200CB01IMR
10	rm	1.8300	2.1898	76	53	65	15.0	420	C314PA10200CB01IMR
16	rm	1.1500	1.3763	98	70	86	17.0	580	C315PA10200CB01IMR
25	rm	0.7270	0.8703	127	92	116	20.1	855	C316PA10200CB01IMR
35	rm	0.5240	0.6276	152	111	142	22.2	1100	C317PA10200CB01IMR
Three Core Cables									
1.5	rm	12.1000	14.4777	23	15	18	10.4	170	C208PA10300CB04IMR
2.5	rm	7.4100	8.8661	29	20	23	11.4	220	C210PA10300CB04IMR
4	rm	4.6100	5.5159	38	26	32	13.4	315	C212PA10300CB04IMR
6	rm	3.0800	3.6853	48	33	40	14.7	400	C213PA10300CB04IMR
10	rm	1.8300	2.1898	63	43	55	16.4	500	C314PA10300CB04IMR
16	rm	1.1500	1.3763	81	57	72	18.6	720	C315PA10300CB04IMR
25	rm	0.7270	0.8703	105	75	98	21.9	1020	C316PA10300CB04IMR
35	sm	0.5240	0.6276	117	85	107	21.2	1310	C417PA10300CB04IMR
50	sm	0.3870	0.4639	139	103	131	24.6	1715	C418PA10300CB04IMR
70	sm	0.2680	0.3220	170	128	166	27.7	2355	C419PA10300CB04IMR
95	sm	0.1930	0.2328	204	156	204	32.1	3205	C445PA10300CB04IMR
120	sm	0.1530	0.1856	231	178	235	34.0	3940	C446PA10300CB04IMF
Four Core Cables									
1.5	rm	12.1000	14.4777	23	15	18	11.3	205	C208PA10400CB08IMR
2.5	rm	7.4100	8.8661	29	20	23	12.3	265	C210PA10400CB08IMR
4	rm	4.6100	5.5159	38	26	32	14.6	385	C212PA10400CB08IMR
6	rm	3.0800	3.6853	48	33	40	16.0	500	C213PA10400CB08IMR
10	rm	1.8300	2.1898	63	43	55	17.9	670	C314PA10400CB08IMR
16	rm	1.1500	1.3763	81	57	72	20.3	920	C315PA10400CB08IMR
25	rm	0.7270	0.8703	105	75	98	24.1	1295	C316PA10400CB08IMR
35	sm	0.5240	0.6276	117	85	107	24.5	1665	C417PA10400CB08IMR
50	sm	0.3870	0.4639	139	103	131	28.7	2220	C418PA10400CB08IMR
70	sm	0.2680	0.3220	170	128	166	32.3	3055	C419PA10400CB08IMR
95	sm	0.1930	0.2328	204	156	204	36.2	4200	C445PA10400CB08IMR

Table 5.2: calculation for the shop

										Circuit load in Watt		
Panel name	location	CCT Identity No.	CCT Ref No.	Laod Type	CB	Cable Size (mm)	Circuit referance	No. of pionts	Watt per piont	R	Y	B
DB-GF-S2	Ground Floor	1	R	lighting	10	3*1.5	L1	5	28.5	114		
			Y	lighting	10	3*1.5	L1	5	28.5		144	
			B	lighting	10	3*1.5	L1	5	28.5	114		
		2	R	lighting	10	3*1.5	L1	5	10.5	114		
			Y	lighting	10	3*1.5	L1	5	28.5		114	
			B	Socekt	16	3*2.5	P1	1	250			250
		3	R	Socekt	16	3*2.5	P1	1	250	250		
			Y				P1				250	
			B				P1					250
		4	R	AC			AC1	1	1800	1200		
			Y	AC			AC2	1	1800		1200	
			B	AC			AC3	1	1200			1200
									Total	1792	1708	1700
			Lighting	Socket	AC	Total KW		Total connected load	5200			
		connected load Watt	600	1000	3600	5.2				Un Balanced %		
		Demand Factor	1	0.5	1	1				5%		
		Demand Load Waat	600	500	3600	5.2				MAX		MIN
										1792		1700
		loads current(A)	8.79									
		I main breaker CB	3*32 A									
		Temp adjesment factor	0.79									
		current after adjesment	6.94									
		Cable section area	5*6									
		conduit size mm2	0.5"									

5.5 Voltage drop :

Calculations of voltage drop as per corporate tables for cables(mV/Amp/Meter), then to currnt and distance then divide 380V .

Table 5.3: voltage drop for cables

Voltage drop for PVC insulated cables

Nominal area of conductor	Voltage drop (mV/Amp/Meter)									
	Single-core cables								Multi-core cables	
	Unarmoured cables				Armoured cables					
	Copper		Aluminum		Copper		Aluminum			
mm²	Flat	Trefoil	Flat	Trefoil	Flat	Trefoil	Flat	Trefoil	Copper	Aluminum
1.5	21.494	21.478	-	-	21.540	21.524	-	-	21.436	-
2.5	13.219	13.203	-	-	13.263	13.247	-	-	13.166	-
4	8.281	8.265	-	-	8.320	8.304	-	-	8.233	-
6	5.576	5.560	-	-	5.614	5.598	-	-	5.532	-
10	3.367	3.351	5.592	5.576	3.403	3.387	5.627	5.611	3.326	5.550
16	2.161	2.145	3.514	3.498	2.193	2.177	3.546	3.530	2.123	3.475
25	1.412	1.396	2.253	2.237	1.440	1.424	2.282	2.266	1.377	2.220
35	1.049	1.033	1.661	1.645	1.076	1.060	1.688	1.672	1.017	1.629
50	0.802	0.786	1.254	1.238	0.827	0.811	1.279	1.263	0.772	1.224
70	0.588	0.572	0.899	0.883	0.611	0.595	0.922	0.906	0.561	0.871
95	0.456	0.440	0.681	0.665	0.475	0.459	0.700	0.684	0.429	0.654
120	0.383	0.367	0.560	0.544	0.402	0.386	0.579	0.563	0.357	0.533
150	0.331	0.315	0.476	0.460	0.348	0.332	0.493	0.477	0.307	0.451
185	0.288	0.272	0.402	0.386	0.302	0.286	0.417	0.401	0.264	0.377
240	0.246	0.230	0.332	0.316	0.259	0.243	0.346	0.330	0.223	0.309
300	0.219	0.203	0.287	0.271	0.232	0.216	0.301	0.285	0.197	0.265
400	0.197	0.181	0.249	0.233	0.209	0.193	0.261	0.245	0.175	0.226

Table 5.4: voltage drop calculation for ground floor

Laod Type	CB	C.S.A (mm2)	No. of pionts	Watt per piont	Total watt	current in the cable	e distance from the board (	Voltage drop (mv/AMP/meter)	V.D (V)	V.D % < 2.5%
lighting (L1)	10	3*1.5	6	10.5	63	0.318181818	3.7	21.494	0.025	TRUE
lighting (L2)	10	3*1.5	13	27	351	1.772727273	12.3	21.494	0.469	TRUE
lighting (L3)	10	3*1.5	2	36	72	0.363636364	16.35	21.494	0.128	TRUE
lighting (L4)	10	3*1.5	4	10.5	42	0.21212121	12	21.494	0.055	TRUE
DB-GF-S1	3*25	5*6	1	6526	6526	11.02998344	10	5.576	0.615	TRUE
DB-GF-S2	3*25	5*6	1	5200	5200	8.788831423	18	5.576	0.882	TRUE
DB-GF-S3	3*25	5*6	1	**5056**	5056	8.545448399	19	5.576	0.905	TRUE
DB-GF-S4	3*25	5*6	1	5048.5	5048.5	8.5327722	16.3	5.576	0.776	TRUE
DB-GF-S5	3*25	5*6	1	5056	5056	8.545448399	15.8	5.576	0.753	TRUE
DB-GF-S6	3*25	5*6	1	3770.5	3770.5	6.372747862	12.5	5.576	0.444	TRUE
DB-GF-S7	3*50	5*10	1	22397.5	22397.5	37.85535612	8.2	3.367	1.045	TRUE

5.6 Power factor correction:

Power factor correction is done by adding capacitors to the Main Distribution Board, and we can calculate the power factor correction by using the following table:

Table 5.5: PF correction table

Original Power Factor	Corrected Power Factor																				
	0.8	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.9	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.0
0.70	0.270	0.296	0.322	0.348	0.374	0.400	0.427	0.453	0.480	0.508	0.536	0.564	0.594	0.625	0.657	0.691	0.728	0.769	0.817	0.877	1.020
0.71	0.242	0.268	0.294	0.320	0.346	0.372	0.399	0.425	0.452	0.480	0.508	0.536	0.566	0.597	0.629	0.663	0.700	0.741	0.789	0.849	0.992
0.72	0.214	0.24.0	0.266	0.292	0.318	0.344	0.371	0.397	0.424	0.452	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821	0.964
0.73	0.186	0.212	0.238	0.264	0.290	0.316	0.343	0.369	0.396	0.424	0.452	0.480	0.510	0.541	0.573	0.607	0.644	0.685	0.733	0.793	0.936
0.74	0.159	0.185	0.211	0.237	0.263	0.289	0.316	0.342	0.369	0.397	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	0.909
0.75	0.132	0.158	0.184	0.210	0.236	0.262	0.289	0.315	0.342	0.370	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739	0.882
0.76	0.105	0.131	0.157	0.183	0.209	0.235	0.262	0.288	0.315	0.343	0.371	0.399	0.429	0.460	0.492	0.526	0.563	0.604	0.652	0.712	0.855
0.77	0.079	0.105	0.131	0.157	0.183	0.209	0.236	0.262	0.289	0.317	0.345	0.373	0.403	0.434	0.466	0.500	0.537	0.578	0.626	0.685	0.829
0.78	0.052	0.078	0.104	0.130	0.156	0.182	0.209	0.235	0.262	0.290	0.318	0.346	0.376	0.407	0.439	0.473	0.510	0.551	0.599	0.659	0.802
0.79	0.026	0.052	0.078	0.104	0.130	0.156	0.183	0.209	0.236	0.264	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.633	0.776
0.80	0.000	0.026	0.052	0.078	0.104	0.130	0.157	0.183	0.210	0.238	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.609	0.750
0.81		0.000	0.026	0.052	0.078	0.104	0.131	0.157	0.184	0.212	0.240	0.268	0.298	0.329	0.361	0.395	0.432	0.473	0.521	0.581	0.724
0.82			0.000	0.026	0.052	0.078	0.105	0.131	0.158	0.186	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.555	0.698
0.83				0.000	0.026	0.052	0.079	0.105	0.132	0.160	0.188	0.216	0.246	0.277	0.309	0.343	0.380	0.421	0.469	0.529	0.672
0.84					0.000	0.026	0.053	0.079	0.106	0.134	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503	0.646
0.85						0.000	0.027	0.053	0.080	0.108	0.136	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477	0.620
0.86							0.000	0.026	0.053	0.081	0.109	0.137	0.167	0.198	0.230	0.264	0.301	0.342	0.390	0.450	0.593
0.87								0.000	0.027	0.055	0.083	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424	0.567
0.88									0.000	0.028	0.056	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397	0.540
0.89										0.000	0.028	0.056	0.086	0.117	0.149	0.183	0.220	0.261	0.309	0.369	0.512
0.90											0.000	0.028	0.058	0.089	0.121	0.155	0.192	0.233	0.281	0.341	0.484
0.91												0.000	0.030	0.061	0.093	0.127	0.164	0.205	0.253	0.313	0.456
0.92													0.000	0.031	0.063	0.097	0.134	0.175	0.223	0.283	0.426
0.93														0.000	0.032	0.066	0.103	0.144	0.192	0.252	0.395
0.94															0.000	0.034	0.071	0.112	0.160	0.220	0.363
0.95																0.000	0.037	0.079	0.126	0.186	0.329
0.96																	0.000	0.041	0.089	0.149	0.292
0.97																		0.000	0.048	0.108	0.251
0.98																			0.000	0.060	0.203
0.99																				0.000	0.143
																					0.000

1. The original power factor is in the first column, which is needed to correction (0.8).
2. We look at the value of the corresponding factor(0.324) of the new (minimum) power factor in the opposite row(0.92).
3. We multiply this factor with the power.

Original power factor=0.8 ,new power factor= 0.92 , the factor= 0.324

Power =563.342 KW

After correction: effective power= 563.324*0.324= 182.51 KVAR

distribute it to 3 stages, every stage is 60KVAR

5.7 Electrical distribution Boards:

Distribution board is a safe system designed for house or building that included protective devices, isolator switches, circuit breaker and fuses to connect safely the cables and wires to the sub circuits and final sub circuits including their associated Live (Phase) Neutral and Earth conductors.

following are the types of Distribution boards:

1. **Main Distribution Board (MDB)**

Main Distribution Board (MDB) is also known as Fuse board or consumer unit where the main protective and isolation devices are installed to provide electricity in a safe range to the connected electrical appliances.

2. **Sub Distribution Board (SDB)**

The Sub distribution board is connected and supplied from the Main Distribution Board through different wires and cables rated according to the load requirement.

3. **Final Distribution Board (FDB)**

The Distribution Board which provide electric supply to the Final and Sub Final Circuits is

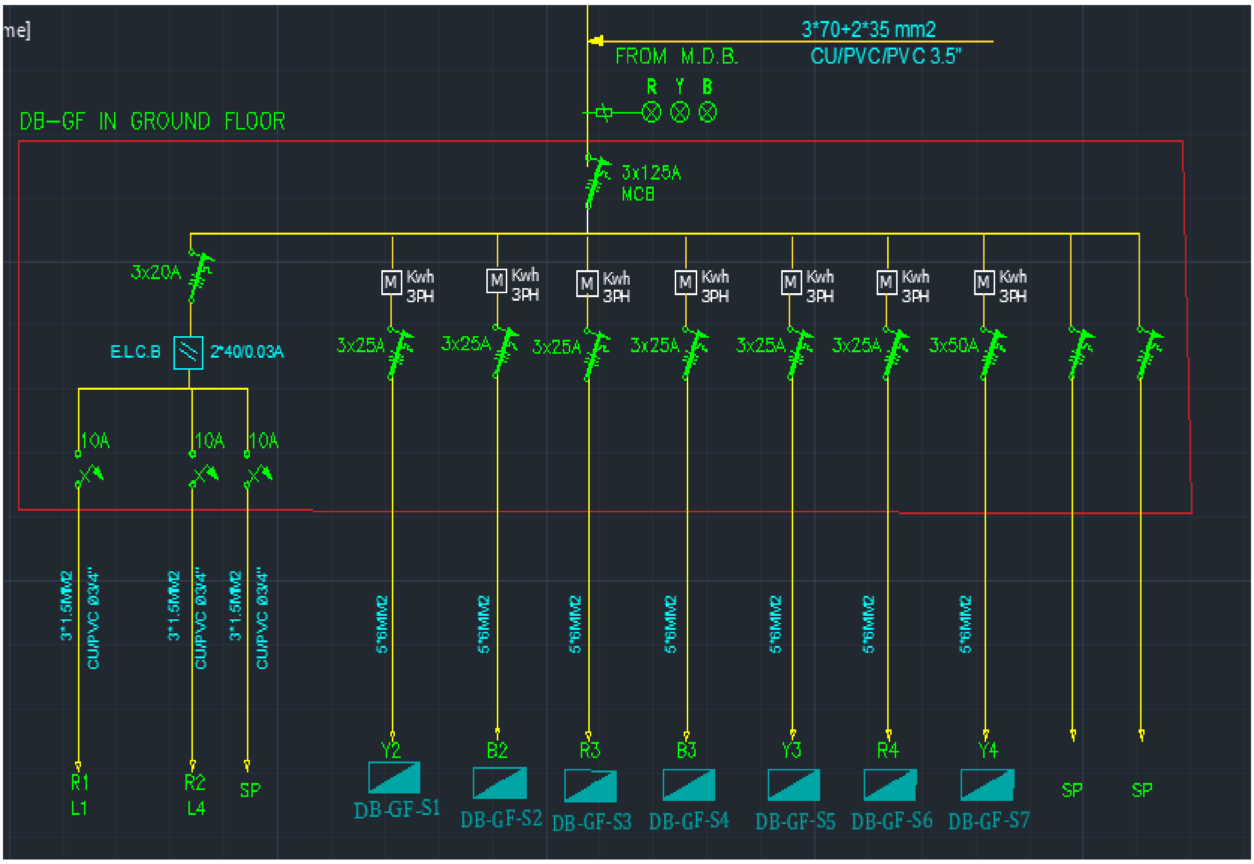


Figure 5.7: DB for GF

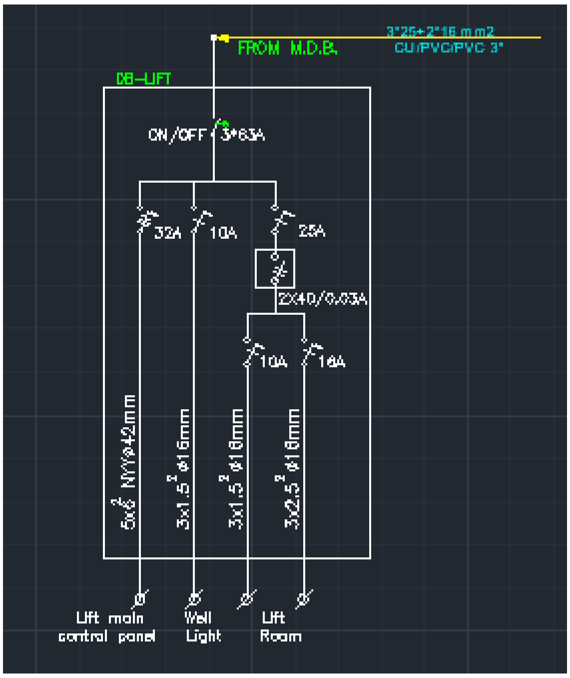


Figure 5.8: DB for lift

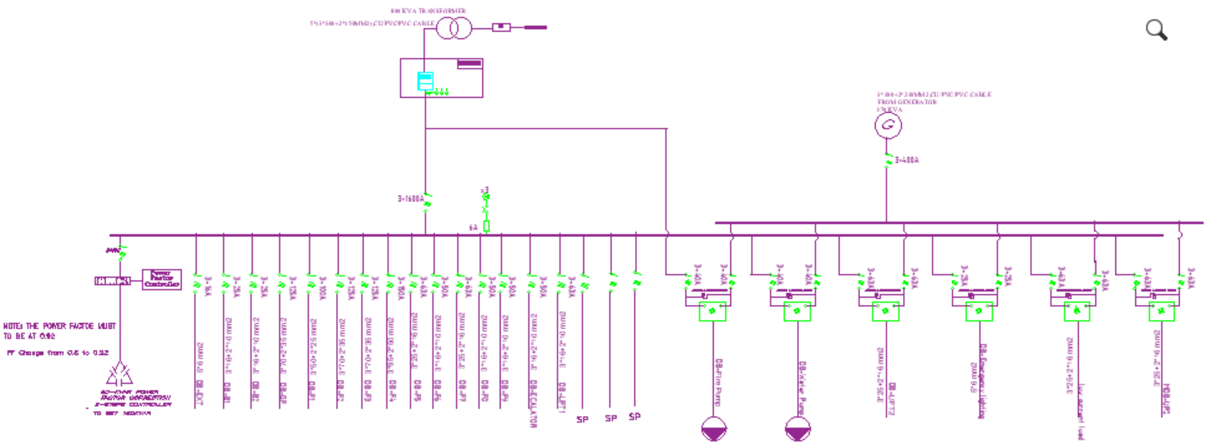


Figure 5.9: MDB

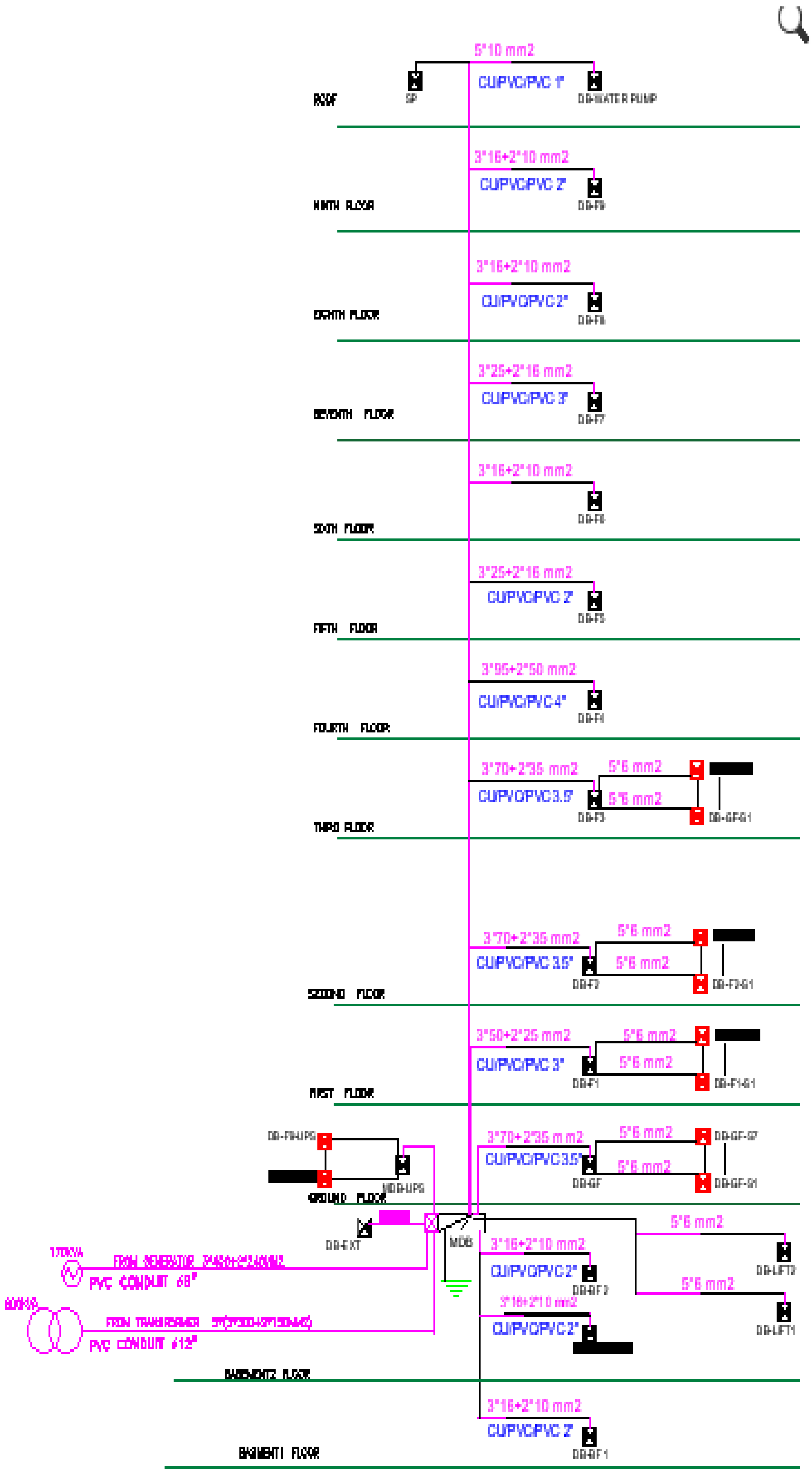


Figure 5.10: riser diagram for DB

Chapter 6

FIRE ALARM SYSTEM

6.1 Overview

this chapter about fire alarm system , component and design

6.2 Objective of this system

The main job of a fire alarm system is to alert the occupants of a building to give them enough time to leave the building safely after smoke or flames have been detected.

6.3 Main components of the system:

6.3.1 Sensors and fire detectors.

6.3.2 Call point

6.3.3 Sound or visual alarm unit

6.3.4 Fire Alarm control panel

6.3.5 Network (Cable & Pipe fitting)

6.4 Steps of design:

1. Choosing the detector according to place application.

Smoke detectors it's divided into two types:

- Ionization detectors which used in fast fire and energy fire.[5]
- Optical smoke detectors used for slow fire, and it not used in in places which contain smoke or dust.[5]

Heat detectors it's divided into two types:

- Fixed types used in places which accuse changes in temperature.[5]

- Rate of rise heat detectors used in places where there is smoke or steam or dust.[5]
- Flame detectors used in places of high altitude.[5]
- Gas detectors work in case of exist pipes to transport gases and it's transported near to the pipes to discover any leakage of gases.[5]

2. Distribution of detectors to cover total area of project and other elements as Manual Switch, alarm bell, flasher, control panel.
3. Drawing network and dividing the project to more zones.

Control panel

1. **Addressable type**

It's used in many places such as hotels and administrative building.

How to work

- The digital fire alarm system wraps through a wire around the building with each detector having its own address.[5]
- This system may contain one or more rings depending on the size of the system and design requirements.[5]
- Its control panel reports each detector separately.[5]
- Each detector has a unique address on the control panel, making it able to display the signal at the specified location.[5]

It’s clear that this help to quickly determine the location of the accident and that is why the fire system entitled digital is the natural choice of large buildings and system that requires more complexities.[5]

Control module

The unit is installed on the alarms and this unit is installed on the speakers so that these speakers are given in the motherboard and convert it to addressable.[5]

Repeater

- Its used in addressable type in wide places, its also used to increase the number of loops when its exceeds the permissible number in the panel , according to the following table:
- According to Jordanian code, if the ceilings are higher than 3m above the floor, the interior distance of the reagents should be reduced.[6]

Call Points

- It is placed at any exit door, in case if anyone in the building see the fire before hearing the alarm, then they press it to launch the siren alarm .
- They are installed in the escape paths of the paths leading to the outside and the corridors leading to the stairs at each floor.
-

6.5 Precaution during design:

1. We must not put call point or glass breaker behind the door that the goal is to be in the way out.
2. Distance from elevators adjustment outlets.
3. Distance between each call point mustn't be less than 30m .

Cables and wires

- Copper wire must be of the appropriate type for purpose.[6]
- Wire segments should be selected so that they don’t cause low voltage and do not affect the efficiency of the equipment.[6]
- The outer shell of the wire shall be of moisture resistant and non-flammable type.[6]
- The electrical connections of the detection and warning system shall be installed on an area not less than 50mm from any other electrical connection.[6]

6.6 Alarm Units

Sounders: Electronic or mechanical audible devices, which are capable of producing a variety of tones. Often, the tone is selectable during installation of the device.[2]

Sirens: Extremely loud devices generally limited in use to outdoor or heavy industrial areas, in high noise level places its used with flasher.[2]

Speakers: Audible devices used in conjunction with voice evacuation messages. [2]

Figure.6.1 :Alarm Units

Smoke Detector Placement

It covers an area with radius of 7.5m , but it use a radius of 5m to insure there are no uncovered area.

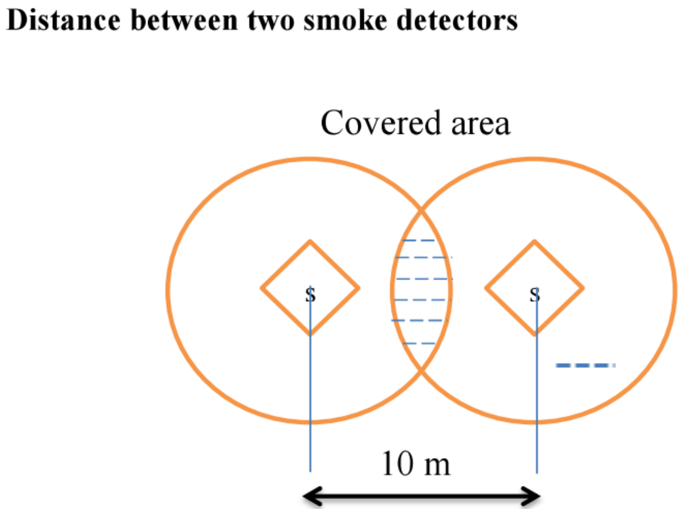
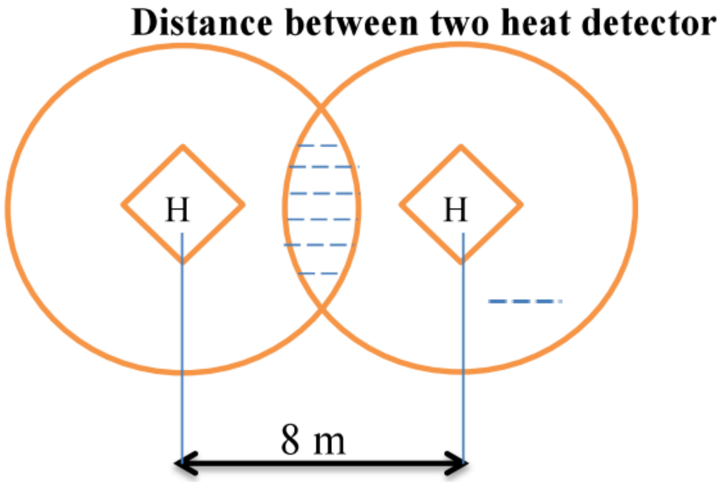


Figure.6.2:Distance between two smoke detectors

Heat Detector Spacing

It covers an area with radius of 5m , but it use a radius of 4m to insure there are no



uncovered area.

Figure6.3:. between two heat detectors

A sample from the project:

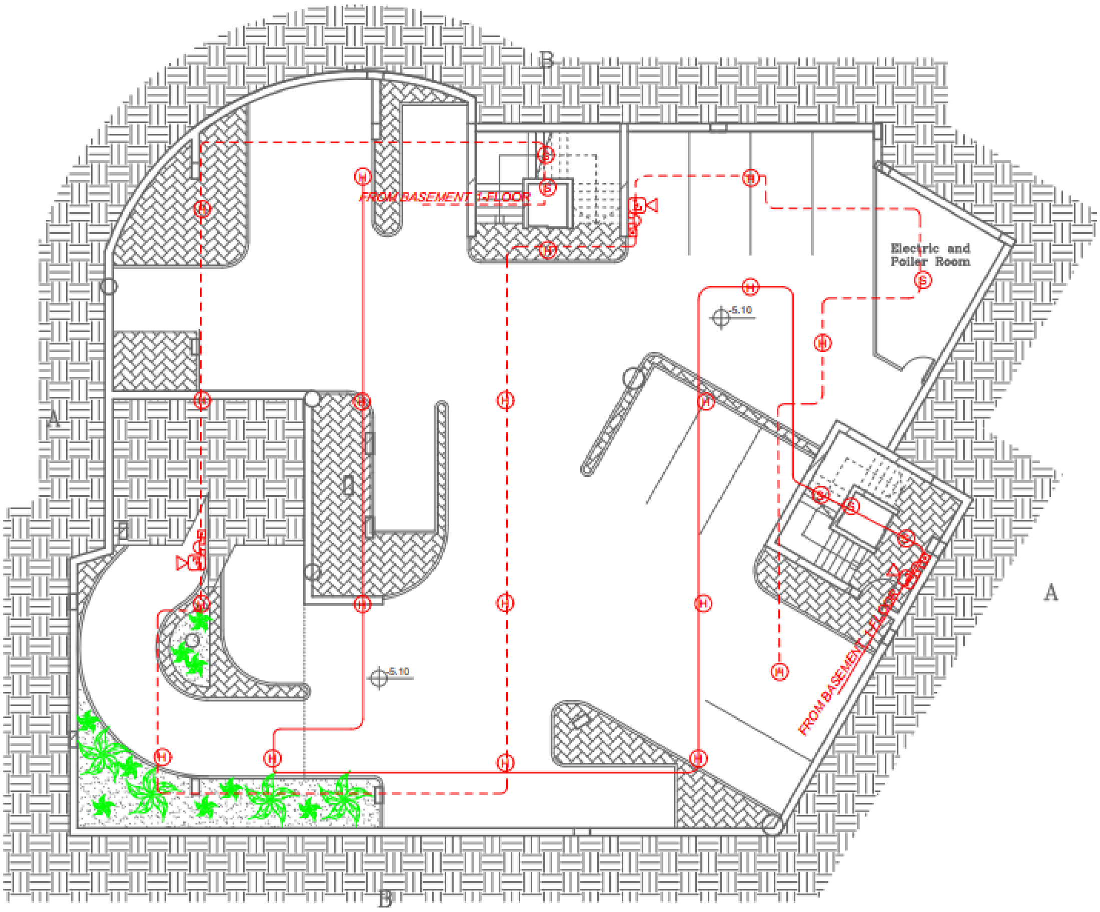


Figure6.4 .basement2 FireAlarm plan

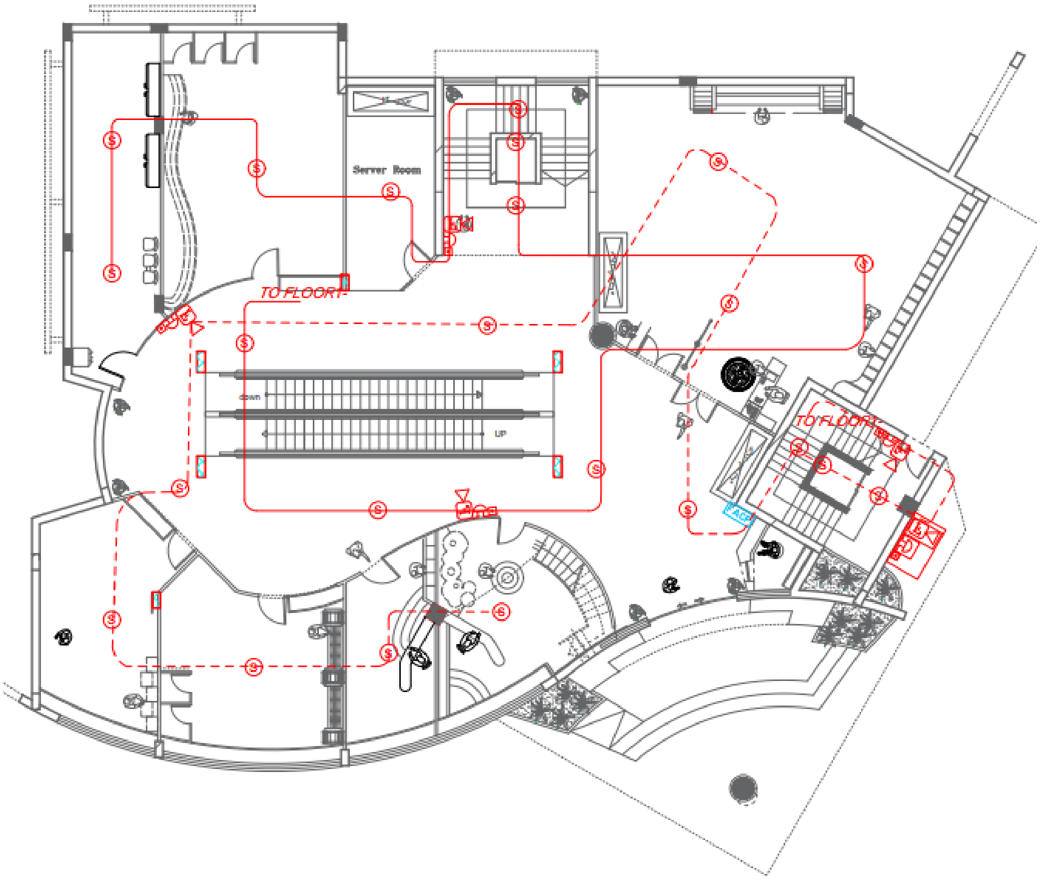


Figure6.5:. Ground-Floor FireAlarm plan

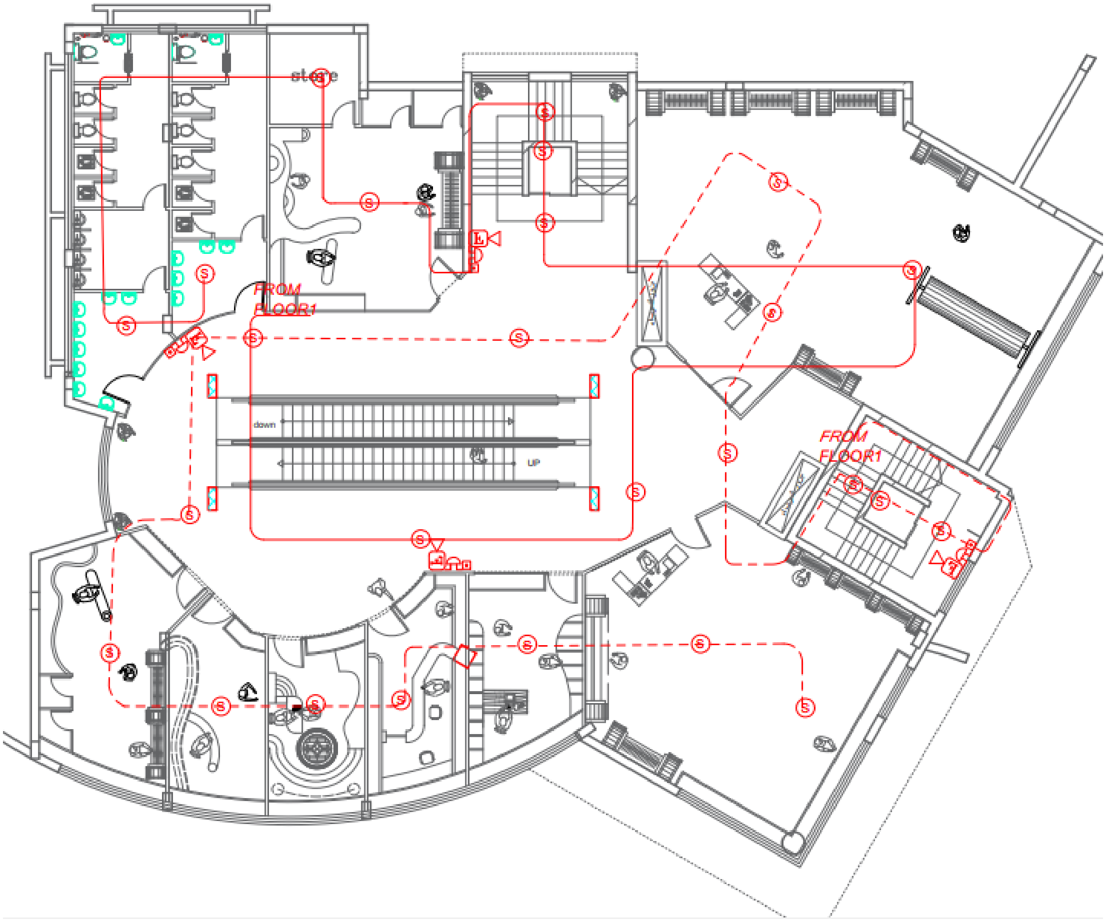


Figure6.6:.floor2 FireAlarm plan

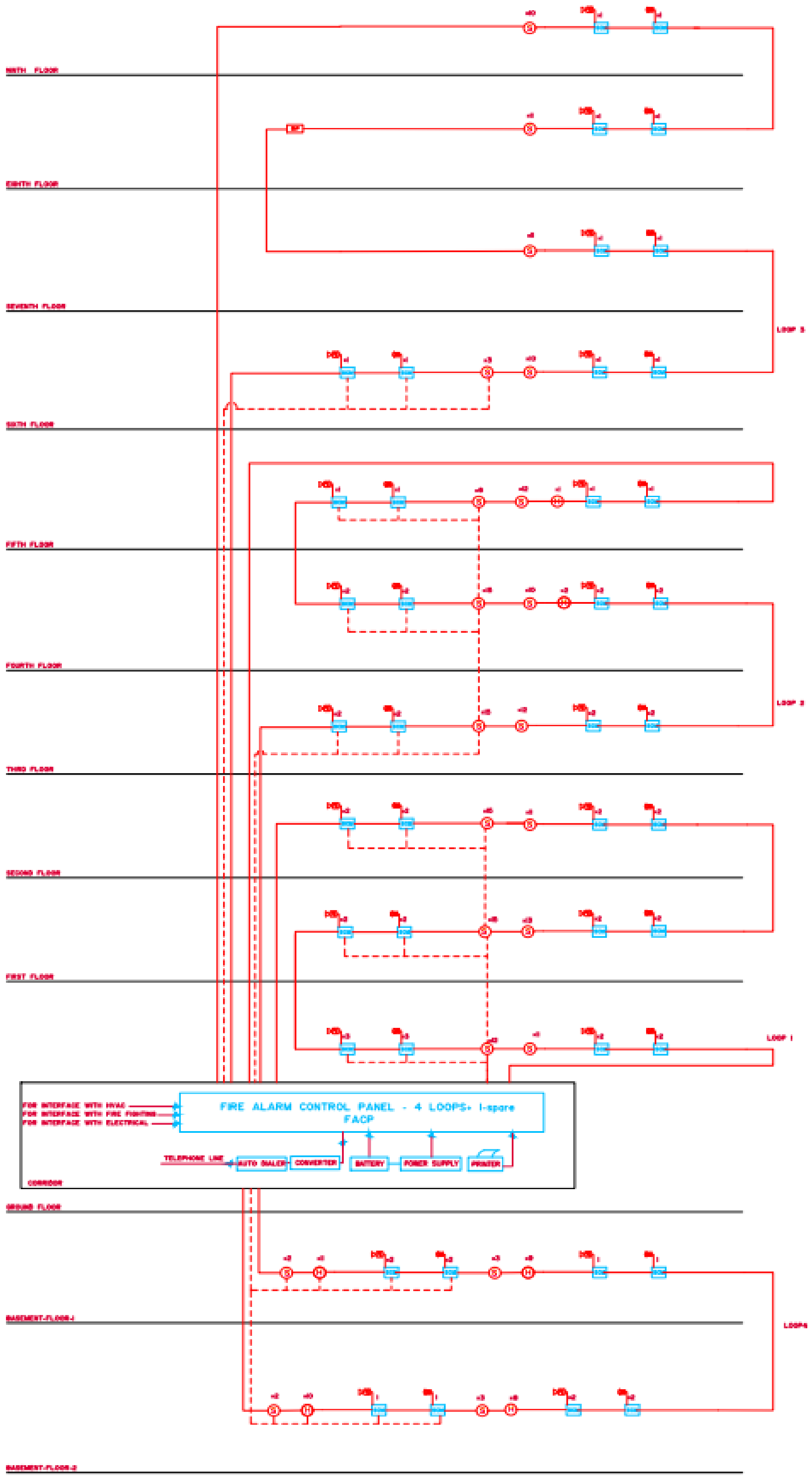


Figure6.7. Fire Alarm Riser Diagram

CHAPTER 7

LIGHT CURRENT

TELEPHONE, DATA AND SOUND SYSTEMS

Chapter Contents:

7.1 Telephone Network

Telephone system is considered one of the most important systems in light current systems, the role of telephone systems comes as it links all the company's phones with each other through an internal network, where employees can easily talk to each other with just three or four digits across The company's internal central , and there is two types of this system[2]:

- Traditional type, and its two types: Analog and Digital.

1. As for the first type(Analog type), it is a normal device that can only make calls, and you can identify it through its wire that consists of one pair of wires.[2]
2. The second type(Digital type), it can do additional operations such as storing numbers and transferring calls , also detect the caller ID .[2]

- Modern system(Internet Protocol).[2]

Telephone system components:

1. IP-telephone : Usually phones uses built-in IP feature, so that it is connected directly to the network.[2]
2. Outlets: usually it use RJ-45 type.[2]
3. Cables/Wires: The data transmission cables consist of 4 pairs of wires here ,and if the distances are more than 90 meters, it uses Fiber Optics type.[2]
4. Patch Panel: It organizes and arranges cables coming from all network points and its function is a complementary function, as the system works without it, but it is used to facilitate the installation and maintenance process.[2]
5. IP Switch: It performs the transfer process between devices according to the centrals orders(IP-PBX).[2]
6. IP-PBX: it has the same task as the traditional one, but here every device will be given its own IP, and it is programmed to control and move between devices.
7. Router: its used to connect two different networks, and its used in telephone system to make calls over the Internet between the different branches of the same company or between different networks in general.[2]

7.2 Data Network

The concept of Data network is generally for computer Network, but in huge buildings it represents a system to connect a group of devices (this devices may be a group of computers and their Peripherals, or groups of IP's camera, or group of IP Telephone or IPTV,etc), these devices are linked together by special wires or wireless to transfer data or to exchange contacts .**[1]**

There is two types of Data Networks: it is either a closed internal network known as LAN (Local Area Network) , or a network connected with external other networks out of the building , which is called WAN(Wide Area Network) .**[1]**

7.2.1 System components

1. Devices that will be connected to the Network such as computers and their peripherals**,** also other light current devices.

2. Data Sockets, and the sockets is not for computers only, we need sockets to connect all digital devices in light current system like Door access controller cameras, of IP Telephone or IPTV, as each one of these devices will need a data socket.

3. Communication media: Structure cabling system (copper and fiber).

4. Patch cord.
5. Patch panel.
6. Rack.
7. Switches.
8. Routers.

7.3 Closed Circuits Televisions (CCTV)

It is a system for visual and audio surveillance, recording the different events that take place in the surveillance areas with sound and video, but in closed circuits, meaning that not all people can see them like regular television, hence the name closed television circuits, this system is used in many important applications such as: security, production management, healthcare, and military fields,…etc **.[14]**

The primary function of the Closed-Circuit Television (CCTV) camera is to provide surveillance of and enhance situational awareness, also CCTVs enable Department Operations staff to perform a number of valuable monitoring, detection, verification, and response activities.**[14]**

Some typical CCTV Camera uses include:

- Detecting and Verifying Incidents
- Monitoring Incident Response and Clearance
- Assisting Emergency Responders
- Monitoring Environmental Conditions (visibility distance, etc.)
- Monitoring assets

A sample from the project:

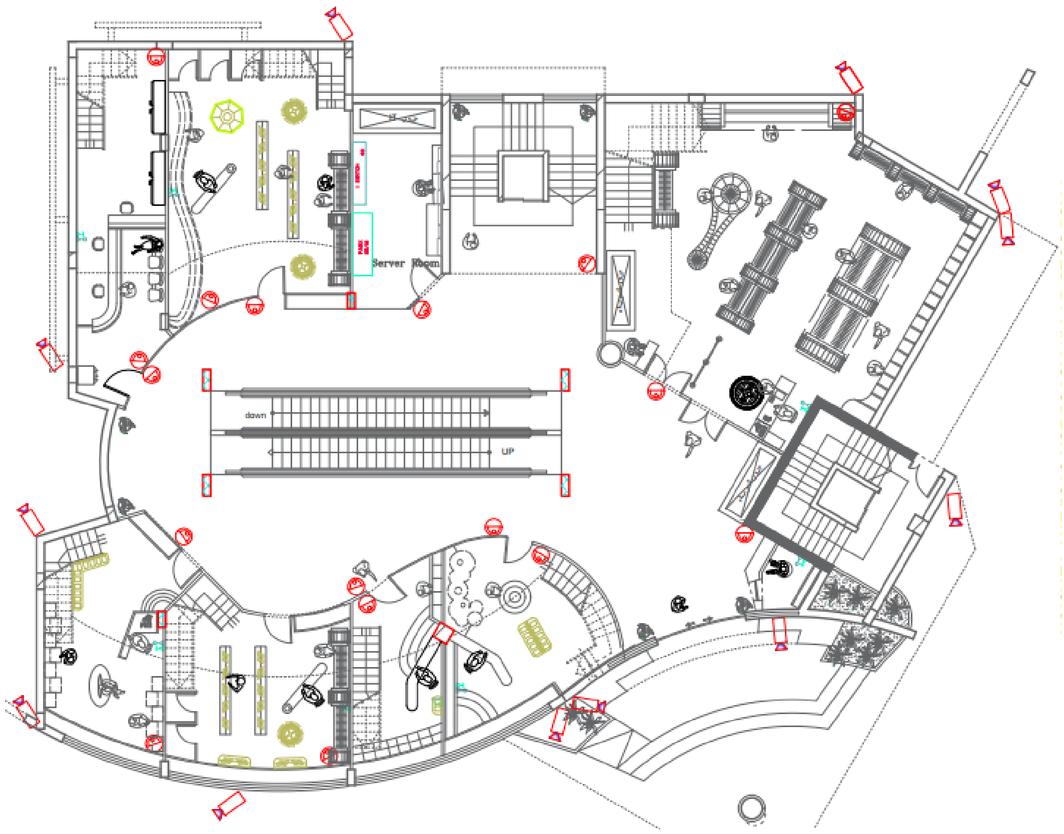


Figure7.1. Ground-Floor CCTV, data, and telephone system plan

Figure7.2. 5th-Floor CCTV, data, and telephone system plan

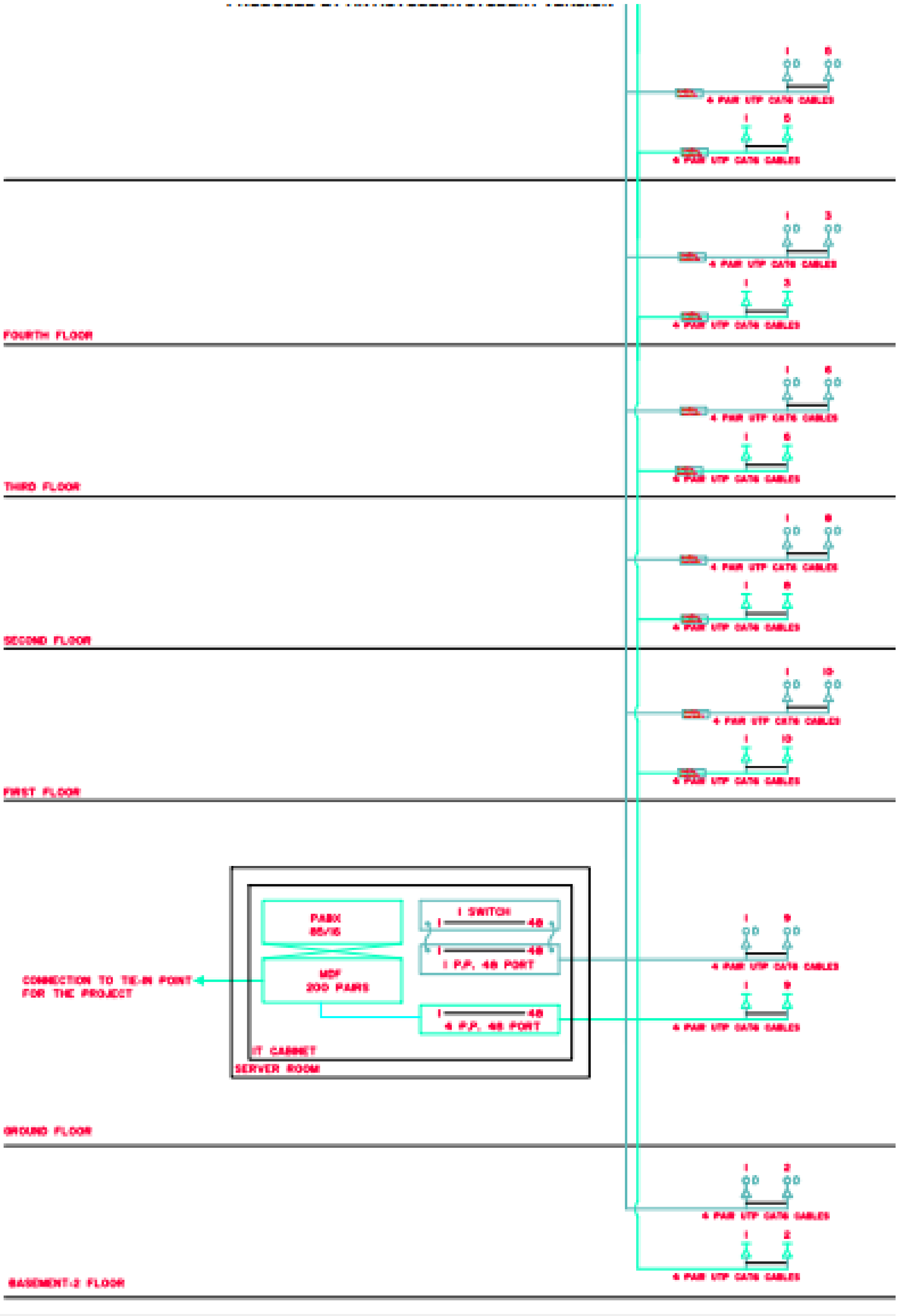


Figure7.3. Data, and Telephone system Riser Diagram

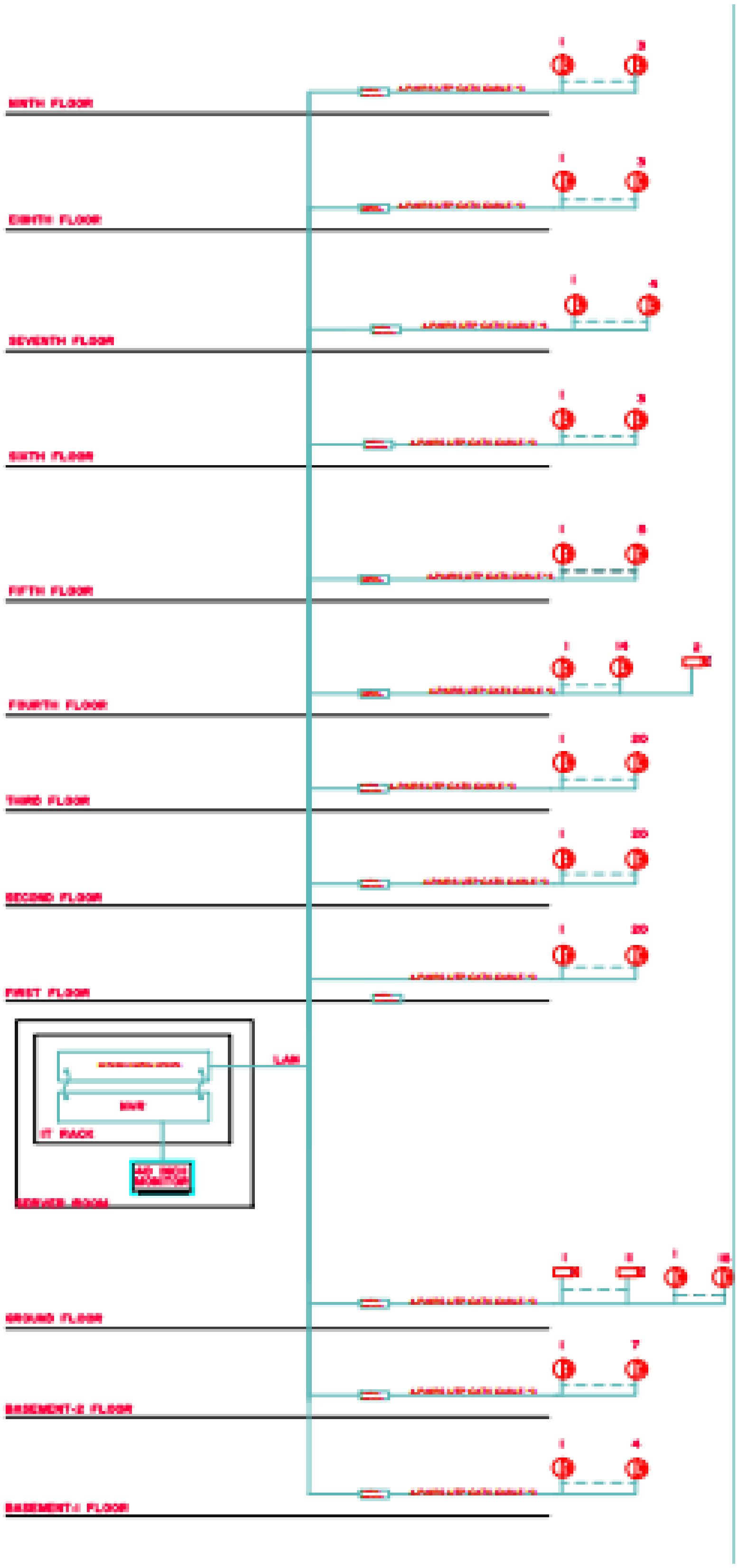


Figure 7.4. CCTV system Riser Diagram

7.4 Sound System

Any audio system consists of a set of basic components:

1. input source: it includes microphones , digital source player and background music players.
2. output source: it includes Speakers, Horns and amplifier.
3. Attenuators(Volume Control).
4. Mixer: It is the device for making adjustments to the audio signal by adjusting its intensity, smoothing or thickening it, or even adding sound effects to it.
5. Cables

A sample from the project:

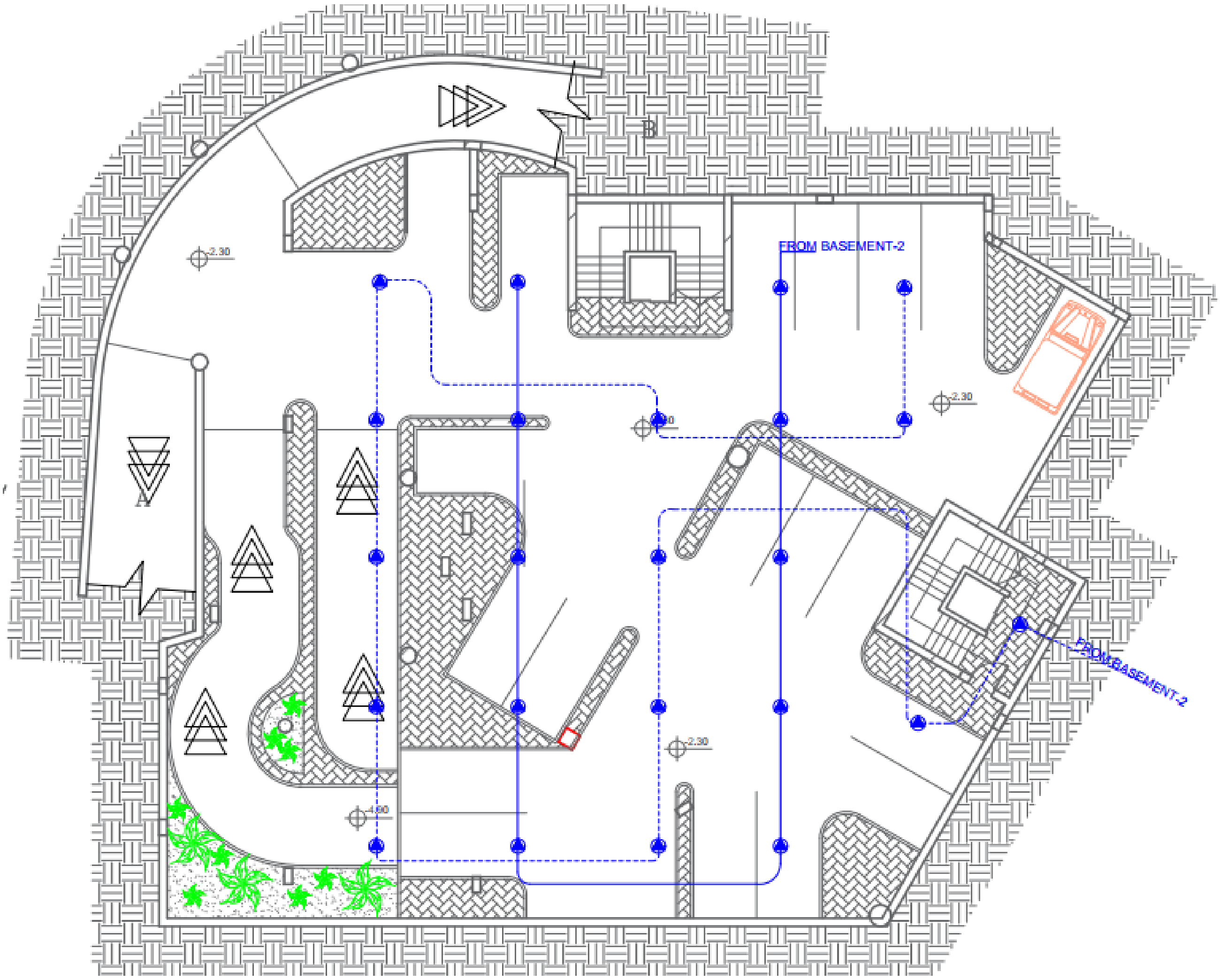


Figure7.5. Basement2 Sound system plan

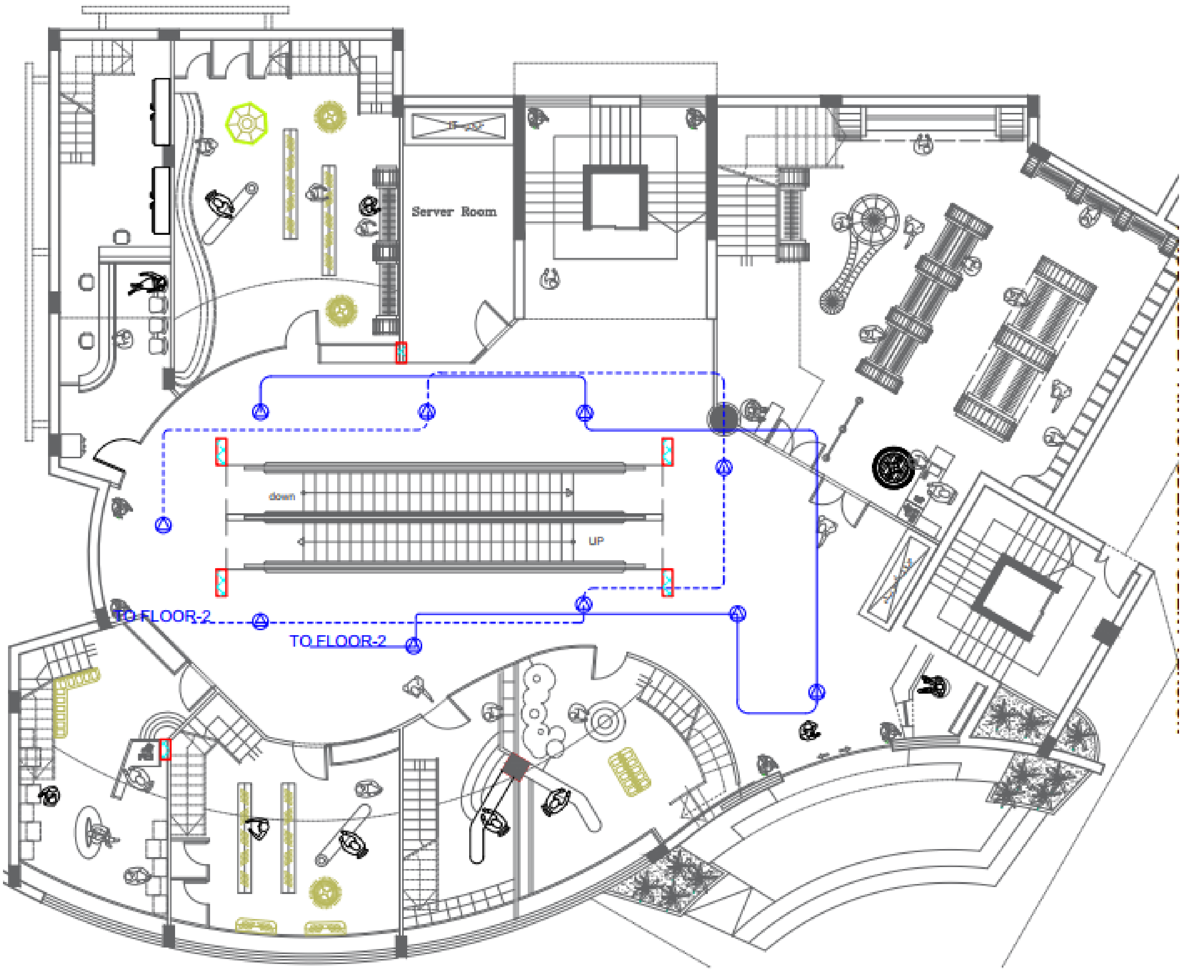


Figure7.6 ground floor Sound system plan

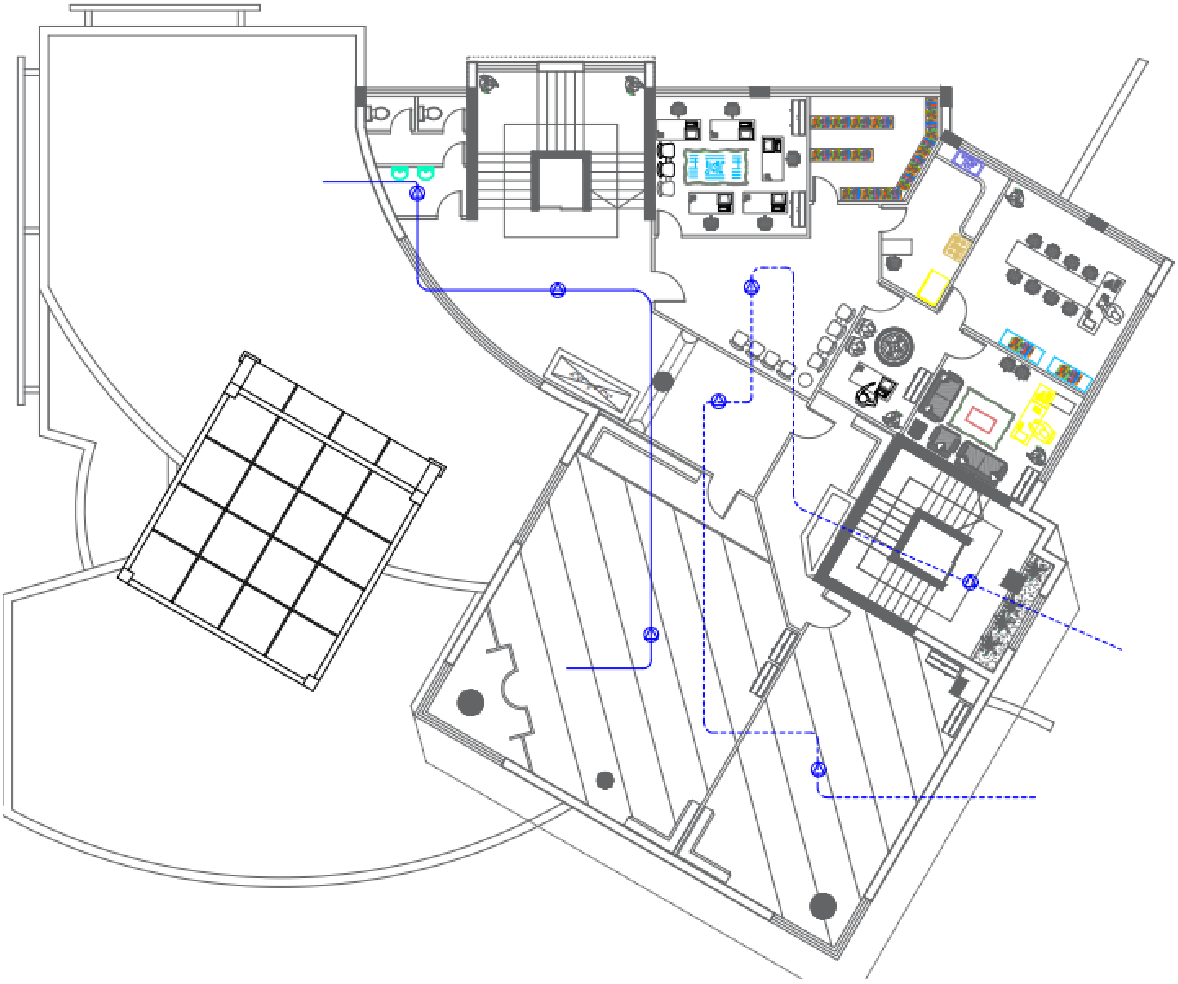


Figure 7.7. 7th-floor Sound system plan

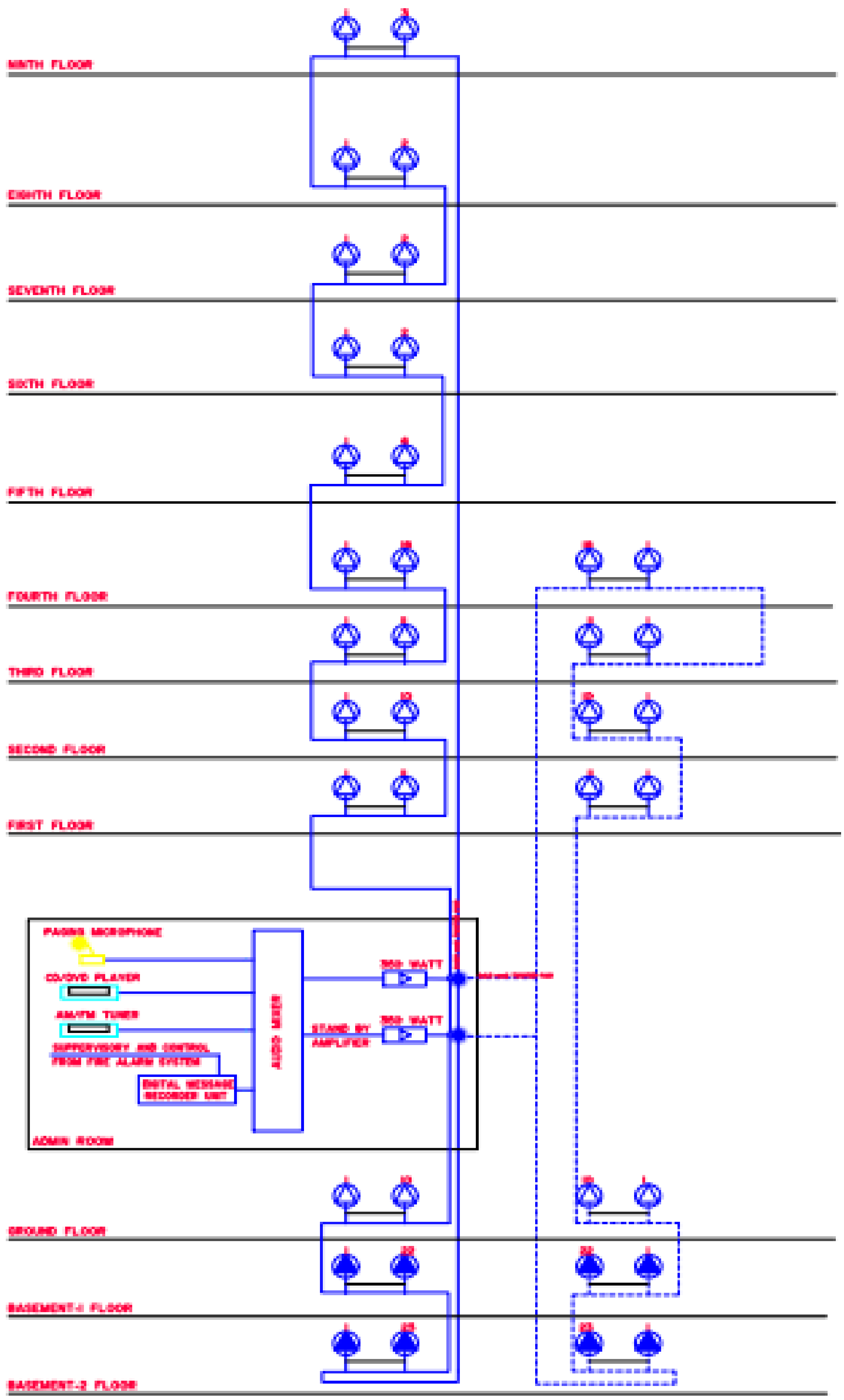


Figure.7.8 Sound system Riser Diagram

CHAPTER 8

EARHTING AND LIGHTINING SYSTEM

8.1 Overview

8.2 Earthing System

8.3 Type Of Earthing

8.4 Lightning Design

8.1 Overview

This chapter about earthing system , types , lightining system principle of design

8.2 Earthing System:

The grounding system is a major part of electrical design. This is to ensure the protection of people and equipment.

Components of the earthing system:

1. Soil having resistivity.
2. Earth rod entombed to a suitable depth.

3.Earthing lead or the grounding conductors that connect the electrode to the objects to be grounded.

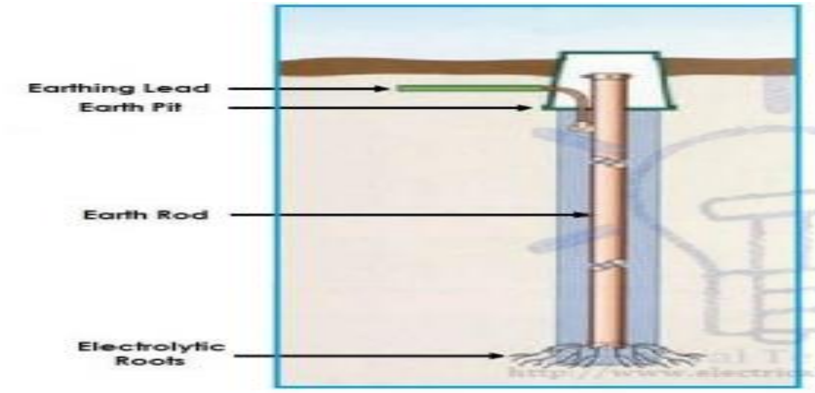


Figure 8.1 : earthing system

There is a very important component which is main earthing terminal (MET)

It is considered the main grounding distributor; it is bas bar (BB) get out of it

protective conductors to all main and sub distribution board, and from protective conductors all nearby metallic objects that do not originally carry current (gas pipes, windows and metal doors) it is known as equal potential conductors.

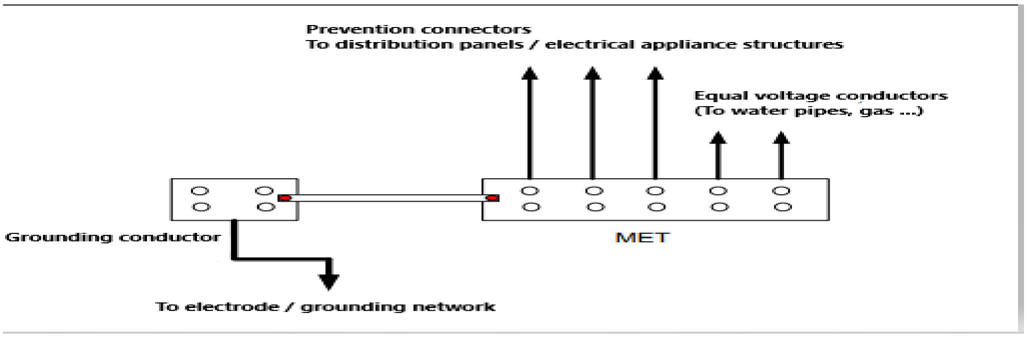


Figure 8.2 : MET

The MET connect with earthing electrode through conductor earthing, so differentiate

must be between protective conductors and earthing conductors, the protective conductors connect with objects to be earthed and with earthing conductor in panels.

The earthing conductors it connects on the one hand to the MET and on the other to earthing network.

The ground resistance value is affected by several factors, the most important of which are:

1. The resistance of the ground in which the electrodes are buried
2. The percentage of humidity in the soil.
3. Number of earthing electrodes.
4. Burial depth.

Earthing Electrodes:

They are the metal rods that are buried in the ground, and the devices to be grounded are subsequently connected through the ground connection. The driven rods buried in the ground are considered the most appropriate and cheapest types of electrodes that are buried at a distance of 3 m in the ground and then connect the ground connection to its end.

Electrodes are used in building constructions, such as rebar in concrete basis, in order to increase efficiency of earthing, During the work of the concrete structure of the basis, a connection is made between one of the bases and the ground conductor of the building.

Earthing leads:

The earthing leads are often copper tape Sectional area within limits 2.5 x 25mm^2.This is to connect the device to be grounded with the ground electrode.

Grounding in buildings:

In special installations in buildings, a separate electrode or earthing grid is usually allocated if one electrode is not sufficient for the distribution transformer, or this electrode is assigned to the main supply box if there is no transformer for the building and there is a separate second electrode for the main low voltage board, this is the second electrode that is connected to MET, then MET is connected to all earthing BB In the sub-distribution boards in the building. the earth pin in socket connect to earth BB in sub-distribution board that Feed socket. There is also a third electrode dedicated to the lightning rod, if any**.**

As for the central air conditioners that are on the roof of the building, they are connected together in series and then they are connected to the ground through two separate electrodes as in the figure.

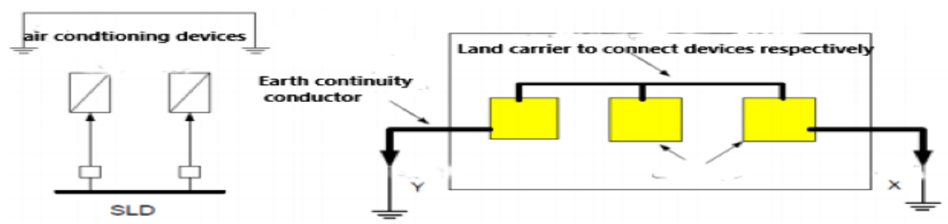


Figure 8.3 : Earthing of AC

8.3 Types of earthing in buildings

1. Grounding by using one or more electrodes instilled into the ground to reach the layers of the earth with low specific resistance, thus obtaining a low ground resistance, and it is connected to the main grounding rod in the electrical board**.**

2. Grounding by copper or galvanized iron tape to be welded with the iron basis of the building and connected to the main grounding rod in the board.

Grounding of communication devices

One of the important things that must be taken into account when grounding communications equipment is that a complete separation is made between the grounding points of the power equipment and the grounding points of the communication equipment.

Because multiple grounding between power system and communication system it may cause some problems especially for communication devices , often the cause is noise resulting from an unsuitable earthing system design.

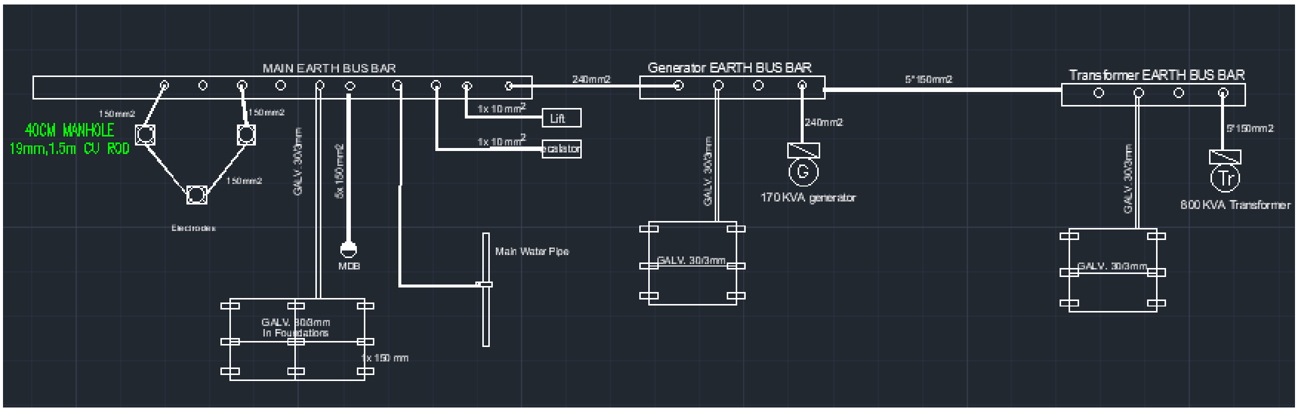


Figure 8.4 : earthing BUS for the mall

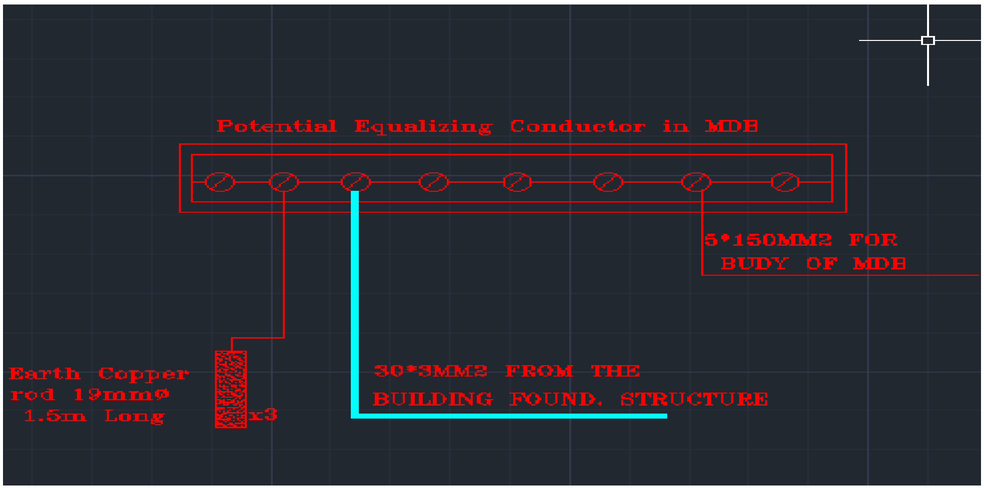


Figure 8.5 : MET for MDB

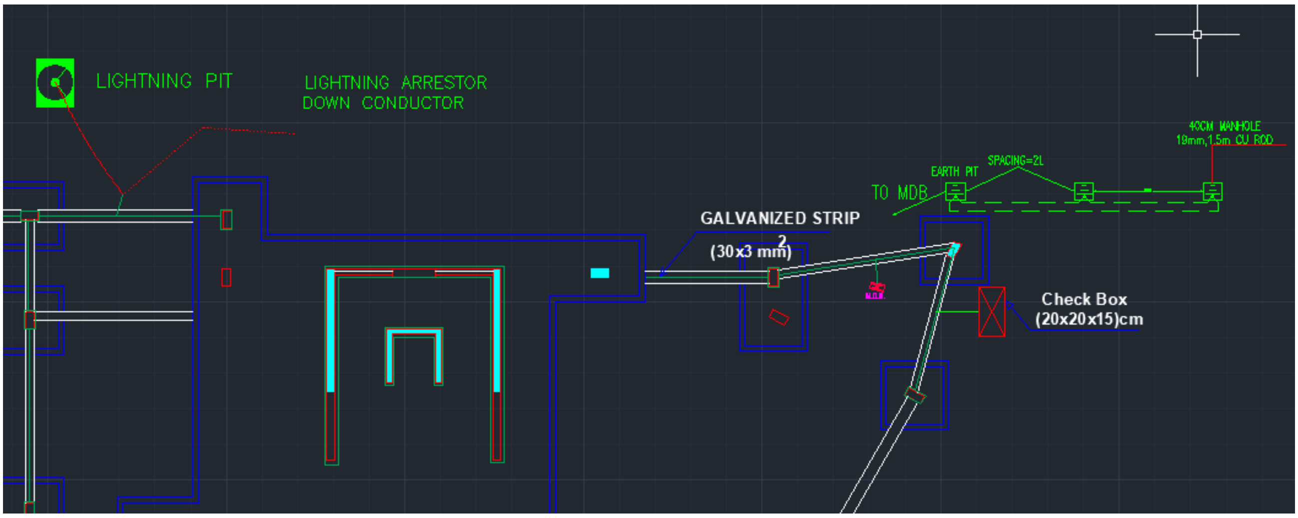


Figure 8.6 : Earthing system for the mall

8.4 Lightning rod:

The system Consists of one entrance or more(air termination) and one Ground conductor or more.

What is Lightning rod:

It is a device connected to the ground and has a pointed tip that is fixed on the building to collect the enormous charges resulting from the lightning strikes and emptying it into the ground.

Its purpose: To protect devices electrical equipment from over voltages Output from weather factors (lightning strike)

When we need Lightning rod:

In High rise buildings, archaeological sites and stores.

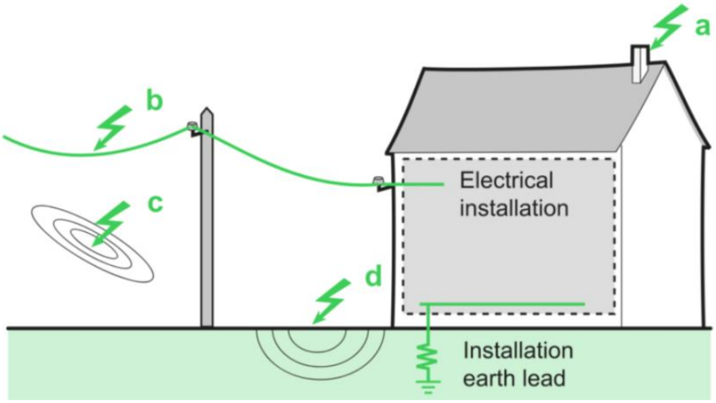


Figure 8.7 : lightining system

Pulsar:

Lightning rod consists of a tapered rod of various lengths it is connected with the ground by cable and electrodes**.**

-- The cable is extended which Connects the lightning rod With electrodes inside Non-metallic pipes To be fixed on the walls External mediated origin Special cleats to be placed Equally spaced At full height Origin.

- Ground bars are made from red copper and no less in diameter About 12 mm.

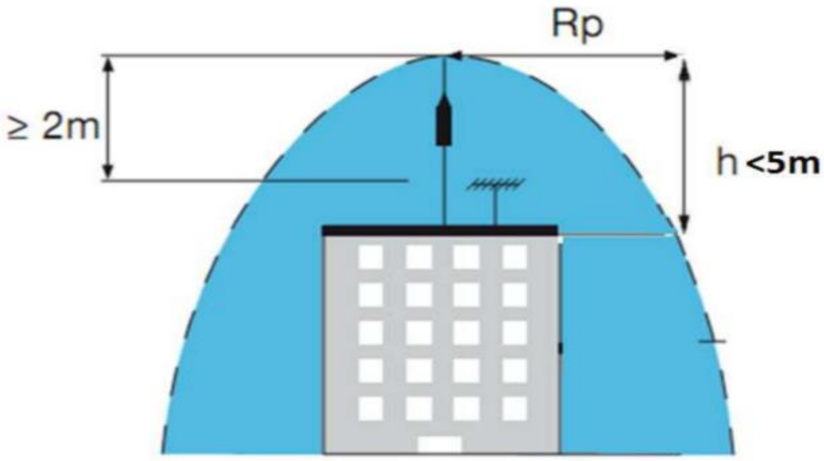
- You have to be Electrodes in closer Possible distance from Enterprise.

- The electrical resistance should not be increased about(10 ohm) for protection system**.**

The designing for lightning rod:

Rp : Radius of protection in a horizontal plane located at vertical distance h from the Pulsar tip

h : Height of the Pulsar tip above the surface(s) to be protected



Pulsar references

ΔT (µs)	Description	Reference	L(m)	Weight (kg)
30	Pulsar 30 stainless steel 2 m Lightning conductor	**HO IMH 3012**	2.0	5.0
45	Pulsar 45 stainless steel 2 m Lightning conductor	**HO IMH 4512**	2.03	5.3
60	Pulsar 60 stainless steel 2 m Lightning conductor	**HO IMH 6012**	2.06	5.7

Figure 8.8 : lightining rod

Pulsar	Pulsar 30	Pulsar 45	Pulsar 60
h (m)			
2	19	25	32
3	28	38	48
4	38	51	64
5	48	63	79
6	48	63	79
8	49	64	79
10	49	64	79
15	50	65	80
20	50	65	80
45	50	65	80
60	50	65	80

Figure 8.9 : lightining table

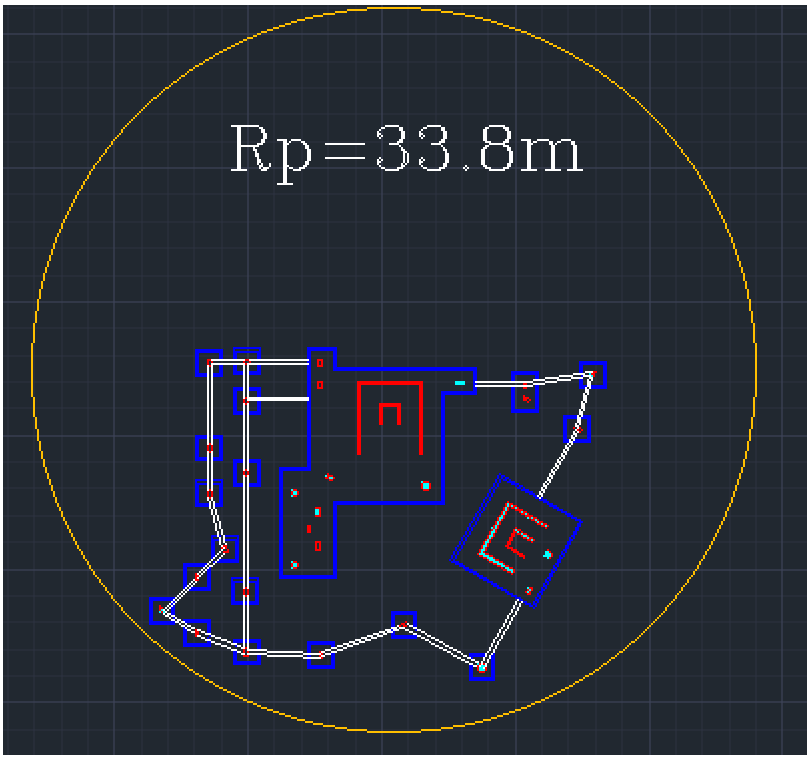


Figure 8.10 : lightining for mall

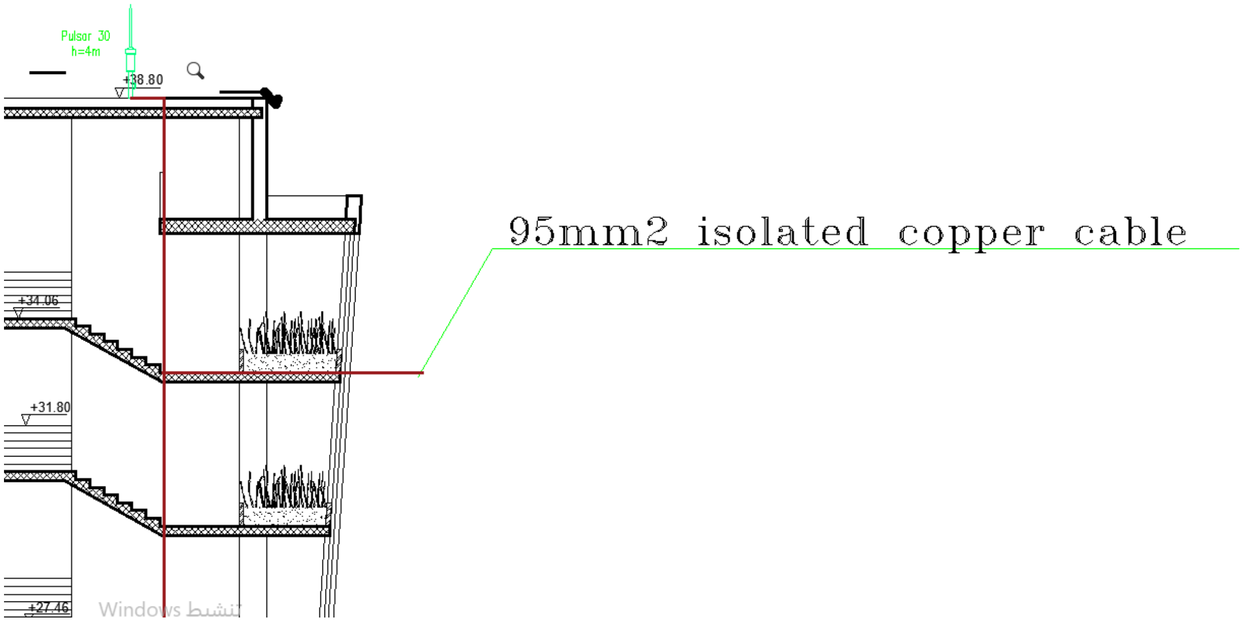


Figure 8.11 : lightining cable

CONCLUSION

The electrical installations in any building are an important part of the designs, which are integrated with other architectural and mechanical works, and the electrical design must achieve safety, ease of maintenance, and achieve international codes and specifications.

The areas of the electrical rooms must be suitable to allow for maintenance work, and they must contain ventilation holes Drainage of oils., and the distribution board of the fire pump must be separate from the main distribution board and the emergency distribution board and its feeding shall be after the transformer and before the main breaker of the transformer.

A commercial mall in Hebron was taken as case study. Due to the nature of the mall use, the lighting and air conditioning loads are the largest among the other loads in order to achieve comfort and attract customers.

The total load for the mall is 751.26 KVA, the capacity for transformer is 800 KVA, and for emergency generator is 170 KVA.

References:

[1] Professor Mahmoud Al-Jilani , The Reference in Electrical Designs and Installations ,Drgilany ,

Cairo, 2019

[2] Professor Mahmoud Al-Jilani , The reference in light current systems, Drgilany ,

Cairo, 2020

[3] Hani Obaid, Planning and designing electrical installations in major projects, AL-shoroq

Cairo, 2001

[4] Mohamed Sobhi , Basis of electrical design, AL -Andalus , Cairo , 2009

[5] Mohamed Al-Masry, Design and audit electrical plans ,AL-Anas, 2010

[6] Nel Sclater and Jhon E. Traister , Hand book of Electrical Design Details ,McGrow-Hill , USA ,2003

[7] Bill Atkinson , Electrical Insolation Design , Blackwell publishing , USA , 2002

[8] Ray C.Mullin and Phil Simons , Electrical Wiring Commercial , Dave Garz , USA, 2012

[9] Joseph B.Wujok and Frank R.Dagostino , Mechanical and Electrical Systems in Architecture Engineering , Pearson Education , New Jersey , 2010

[10] Walter T.Gronzik and Alisen .G.Kwok ,Mechanical and Electrical Equipment for Building, Jhon Wiley & Sons .inc , USA , 2010

[11] Engineering Ministries , International Electrical Design Guide , USA, 2019

[12] H.Merz , T.Hanseman and C.Hubner , Building Automation , Springer , Germany , 2009

[13] American Code NEC , 2017

[14] PTZ technonogy ,https://www.videosurveillance.com/tech/ptz-technology.asp,30 , 30 Oct 2020

[15] Christopher Lanni and Tim Sutton, https://www.securitymagazine.com/articles/88854-pros-and-cons-for-ip-vs-analog-video-surveillance,30 Oct 2020

[16] Derek Crippin, https://www.alarmnewengland.com/blog/smoke-detector-types-and-their-differences,4 Nov 2020

[17] Sintinel Fire Product , https://www.sentinelfire.co/what-is-a-heat-detector ,4Nov,2020

[18] Caves Mart , https://www.covesmart.com/blog/how-a-heat-detectors-works ,4Nov,2020

[19] Inst Tools , https://instrumentationtools.com/flame-detectors-working-principle/#:~:text=There%20are%20three%20types%20of,combination%20of%20UV%20, 10 Nov 2020

[20] Bill Allan, https://professional-electrician.com/technical/napit-effectively-connected-extraneous-metalwork , 30 Nov 2020

Appendix

Appendix A: Load estimation for mall

shops

shop name	number	area	lighting VA/m2	lighting(VA)	socketVA/m2	socket(VA	HVAC VA/m2	HVAC (VA)	LOW CURRENT(VA/m2)	Low Carrent VA
Kids p;ay shop	1	30	25	750	15	450	50	1500	5	150
Furniture shop	1	80	25	2000	10	800	50	4000	5	400
shoe shops	1	30	30	900	15	450	50	1500	10	300
jewery shop	3	120	30	3600	10	1200	50	6000	5	600
beauty salon	1	30	35	1050	10	300	50	1500	5	150
Electrical tools store	2	60	33	1980	15	900	70	4200	5	300
Clothing and sports equipment store	1	80	25	2000	10	800	50	4000	5	400
Men's clothing store	1	30	30	900	10	300	50	1500	5	150
Women’s clothing store	3	120	30	3600	10	1200	50	6000	5	600
Baby clothing store	3	120	30	3600	10	1200	50	6000	5	600
Antique store	1	40	30	1200	10	400	50	2000	5	200
Nuts store	1	30	35	1050	10	300	50	1500	5	150
Sweet shop	1	40	25	1000	10	400	50	2000	5	200
Exchange store	1	40	25	1000	10	400	50	2000	5	200
Photographer store	1	30	25	750	10	300	50	1500	5	150
Cocktail shop	1	30	30	900	15	450	50	1500	5	150
Phoramcy	1	30	25	750	10	300	50	1500	5	150
Bag store	1	30	25	750	10	300	50	1500	5	150
Super Market	1	250	30	7500	10	2500	70	17500	5	1250
Food stores	3	120	25	3000	10	1200	50	6000	5	600
Computer hardware store	1	50	25	1250	15	750	50	2500	10	500
Fabrics store	1	50	30	1500	10	500	50	2500	5	250
Stationery store	1	40	25	1000	10	400	50	2000	5	200
Carpet shop	1	80	25	2000	10	800	50	4000	5	400
Makeup store	1	40	30	1200	10	400	50	2000	5	200
Flower shop	1	30	25	750	10	300	50	1500	5	150
total		1630		45980		17300		87700		8150
			TOTAL	**159.13**		**KVA**				

Office

Office	unit area	number of units	total area	lighting VA/m2	SOCKET (VA/m2)	HVAC (VA/m2)	LC (VA/m2)
one office with secretary	40	10	400	20	15	60	10
Two office with secretary	70	6	420	20	15	60	10
Three Office with secretary	90	3	270	20	15	60	10
Total			1090	21800	16350	65400	10900
		TOTAL	114.45	KVA			

Restaurants

Unit	Area	lighting VA/m2	lighting(VA)	socket VA/m2	socket(VA	HVAC VA/m2	HVAC (VA)	LOW CU	LC VA
Resturant	100	30	3000	20	2000	70	7000	5	500
Cafe	150	30	4500	20	3000	70	10500	5	750
			7500		5000		17500		1250
		TOTAL	31.25 KVA						

Stores

area	lighting VA/m2	lighting(VA)	socket VA/m2	socket(VA	LOW CURRENT(VA/m)	LC VA
326	6	1956	1	326	5	1630
	TOTAL	KVA	3.912			

Corridors

area	lighting VA/m2	lighting(VA)	HVAC VA/m2	HVAC (VA)	LOW CURRENT(VA/m)	LC VA
1116.3	6	6697.8	50	55815	5	5581.5
	TOTAL	KVA	68.0943			

The garage

The garage	مساحة	lighting VA/m2	LOW CURRENT(VA/m2)	Hoods
	1125	5	5	30
		5625	5625	33750
		TOTAL		45 KVA

Yards

Yards	Area	lighting VA/m2	LOW CURRENT(VA/m)		children's toys(cars ….)	100 m2	35KVA
	700	30	5				
		TOTAL	59.5 KVA				

Management

	area	lighting VA/m2	lighting(VA)	socketVA/m2	socket(VA	LC VA/m2	LOW (VA)	HVAC(VA/m)	HVAC VA
entrance	10	6	60		0	5	50	50	500
Secretarial	12	20	240	15	180	10	120	60	720
a kitchen	9	15	135	10	90	5	45	50	450
Office of the Director	20	20	400	15	300	10	200	60	1200
Meetings room	35	20	700	15	525	5	175	60	2100
Staff room	20	20	400	15	300	10	200	60	1200
Archives	12	15	180	10	120	5	60		0
Sanitary units	7	30	210	15	105	10	70	70	490
			2325		1620		920		6660
					TOTAL	11.525 KVA			

TOTAL

Total Previous loads in the MALL	536.2613	KVA
Fire Pump	20	KVA
Water Pump	18	KVA
Cooking equipmemt	100	KVA
UPS	24	KVA
Two elevotrs	50	KVA
Server room	3	KVA
Total estimated loads in theMALL	751.2613	KVA

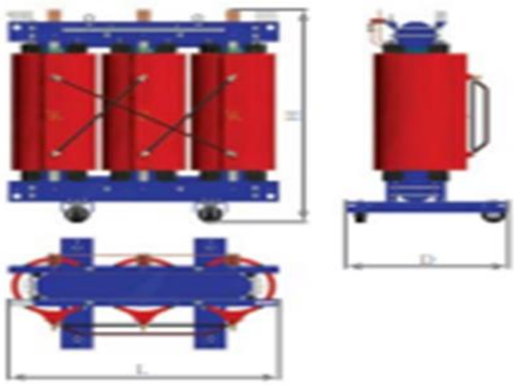
Appendix B: Catalog of 800 KVA transformer

alfanar Cast Resin Transformers family according to International Standards (Copper foil)

Pn (kVA)	Po (W)	Io %	Pcc120° (W)	Vcc%	LpA (dB)	Weight (kg)	Length x Depth x Height	Wheel dist.
100	400	2,2	2100	4	48	490	960x600x1150	520
160	520	1,8	2650	6	49	680	1140x600x1240	520
200	610	1,7	2950	6	50	800	1140x600x1320	520
250	700	1,6	3650	6	52	900	1200x600x1340	520
315	800	1,5	4250	6	54	1020	1200x750x1440	670
400	980	1,2	5000	6	55	1250	1290x750x1510	670
500	1100	1,1	6000	6	56	1400	1320x750x1580	670
630	1390	0,9	7100	6	57	1700	1410x850x1680	670
750	1550	0,8	7800	6	58	1800	1440x850x1700	670
800	1650	0,8	8500	6	58	1900	1440x850x1800	670
1000	1900	0,7	10000	6	61	2400	1530x1000x1870	820
1250	2300	0,6	11600	6	63	2700	1530x1000x2070	820
1500	2500	0,6	13500	6	64	3100	1620x1000x2090	820
1600	2700	0,6	14000	6	65	3300	1650x1000x2200	820
2000	3400	0,5	17000	6	67	4000	1800x1300x2230	1070
2500	4000	0,4	20000	6	68	4800	2000x1300x2250	1070
3150	4600	0,3	25100	8	69	5800	2100x1300x2270	1070

All the above cast resin transformers fulfill the following common technical data:

Distance measures in :	Millimetres
Voltage ratio :	11±2x2,5% / 0,4kV or 10±2x2,5% / 0,4kV;
Insulation levels Primary / Secondary :	12 - 35 - 75 / 1,1 - 3kV
Partial discharge level :	< 10 pC
Insulation thermal class :	F / F - 100 / 100 K
Vector group :	Dyn11
Frequency :	50 Hz
Available environmental classes :	E2 / E3
Available climatic classes :	C1 / C2
Fire classification :	F1
Conductor material :	Copper foil



NOTE: Power ratings higher than 3150 kVA, and or different voltage ratio, or impedance value, as well as particular design for special dedicate application will be available under request and submission of technical specification.

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